Professor G. Marshall Kay
with many thanks
for the [illegible]
Ronald Tripp

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TRILOBITES FROM THE "CONFINIS" FLAGS (ORDOVICIAN) OF THE GIRVAN DISTRICT, AYRSHIRE

BY

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[With Four Plates]

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I.—Trilobites from the *confinis* Flags (Ordovician) of the Girvan District, Ayrshire.

By **Ronald Pearson Tripp.** *Communicated by* Professor T. NEVILLE GEORGE. (With Four Plates.)

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SYNOPSIS

THREE new genera and seventeen new species of trilobites from the Flags with *Valcourea confinis* (Salter) of the Girvan District are described and named, and thirty-six species are figured. The genera constitute a normal Middle Ordovician assemblage for the Girvan District; none of the species is known elsewhere. There is a close resemblance to the fauna of the Lower Edinburg Formation of the Appalachian Valley of the U.S.A., and many of the generic stocks are known earlier only from the Chazy and Lincolnshire Formations of North America.

INTRODUCTION

THIS study was undertaken at the suggestion of Professor Alwyn Williams, and is based partly on specimens collected in the course of his field work in the District. I am most grateful to Professor Williams for his assistance, and for introducing me to the Kirkdominæ locality, amongst others. I am indebted to the following for assistance and for the loan of specimens: Dr W. T. Dean, British Museum (Natural History), London (BM); Professor T. N. George and Dr E. D. Currie, Hunterian Museum, Glasgow (A.); Dr J. C. Harper, Liverpool University; Professor Marshall Kay, Columbia University, New York; Dr C. D. Waterston, Royal Scottish Museum, Edinburgh (RSM); Mr R. B. Wilson, Geological Survey of Great Britain (Scottish Office), Edinburgh (GSE). The initials following the name of an institution are those used subsequently in referring to particular specimens. Sincere thanks are also due to Dr John Temple for his critical reading of the manuscript.

The terminology used is essentially that adopted in the *Treatise on Invertebrate Paleontology,* **O.** Almost all the material is preserved as internal and external moulds; the descriptions refer to the external surface of the exoskeleton unless otherwise stated. The length of a part is the distance measured parallel to the median line between its extremities; the width is the corresponding measurement at right angles to the median line. Where there is any doubt whether a part belongs to the species to which it has been attributed, the description is placed in square brackets. Figured specimens collected by Professor Williams and the author have been presented to the Hunterian Museum, Glasgow University.

The trilobites described are from the *confinis* Flags, which are exposed along the north side of the Stinchar Valley, immediately underlying the Stinchar Limestone. The facies and grid references of the three chief localities are as follows:

Kirkdominæ.—Decalcified light-brown weathering mudstone, exposed at the east end of the small wood on the brow of Kirkdominæ Hill. Nat. Grid Ref. NX 225000/592100.

Minuntion.—Brown weathering, nodular and flaggy, calcareous sandstones and siltstones exposed on north side of the cart-track leading up to the old limestone quarry west of Minuntion Farm. Nat. Grid Ref. NX 222075/591125.

Bougang.—Green weathering, calcareous sandstone and siltstones with occasional pebbles of serpentine, exposed on the north side of the old limestone quarry, 300 yds. south-west of Bougang Farm. Nat. Grid Ref. NX 211425/585450.

The following is a list of the species recorded in this paper, and of their relative frequency at the three main localities (vc indicates very common, over 100 specimens; c indicates common, 10–100 specimens; r indicates rare, fewer than ten specimens).

	Bougang	Kirkdominæ	Minuntion	Page	Figures
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SYSTEMATIC DESCRIPTIONS

Family REMOPLEURIDIDÆ Hawle and Corda 1847

Genus *Remopleurides* Portlock 1843

Remopleurides procax n.sp.

(Pl. I, figs. 1–8)

Diagnosis.—Glabella weakly convex; anterior tongue broad and prominent. Free cheeks narrow, with slender subgenal spines one-half length of cranidium. Glabella and occipital and thoracic rings tuberculate.

Holotype.—A.5215 (cephalon). Pl. I, figs. 1*a*–*c*. Bougang.

Paratype.—A.5214 (thoracic segments and pygidium). Bougang.

Other material.—Cranidia, free cheeks, thoracic segments and pygidia from Bougang and Minuntion.

Dimensions.—

	Holotype	GSE 11886
Length of cranidium	6·1 mm.	8·2 mm.
Width of cephalon (estimated)	9·4 mm.	. .
Width of glabella (maximum)	6·5 mm.	6·7 mm.
Width of anterior tongue	3·2 mm.	3·7 mm.
Width between posterior extremities of eyes	4·3 mm.	4·5 mm.
Length of occipital ring	. .	1·2 mm.
Length of subgenal spine	3·0 mm.	. .

Description.—Cephalon, excluding subgenal spines, transversely oval in outline. Glabella urceolate, variable in relative proportions, greatest width situated far back, weakly convex in both directions. Anterior tongue moderately long, almost parallel sided, strongly convex transversely, bent gently, but somewhat variably, downwards. Positions of two pairs of lateral glabellar furrows occasionally indicated on external moulds by absence of tuberculation. Occipital ring strongly arched transversely. Occipital furrow deep and broad. Axial furrows deep on side next to glabella, shallow on palpebral lobe side; shallow fossulæ at the front. Palpebral lobes flattened, narrow, indenting glabella at back, narrowing out by base of tongue. Anterior branches of facial sutures join in front of tongue; posterior branches run obliquely outwards and backwards, traversing outer flanks of articulating sockets.

Eye long, vertical, narrow, more strongly curved in posterior than in anterior half; composed of about 160 vertical rows of lenses, with twenty-four lenses in longest rows—about 3000 lenses in all. External rim of eye lobe marked off by sharp furrows. Outer area of cheek narrow posteriorly, narrowing out at anterior extremity of eye, sloping outwards; a longitudinal swelling develops towards back. Posterior border swollen, genal angle rectangular; posterior border furrow broad, dying out rapidly. Subgenal notch narrow, a little longer than border. Subgenal spine slender, directed straight backwards, about one-half length of cranidium. Doublure of free cheek narrow and strongly convex posteriorly, widening and flattening forwards to slope backwards and downwards beneath tongue, crossed by median suture. The elongated conical pit in doublure opposite the fossula not strongly developed.

Thorax composed of eleven segments; rings and pleuræ taper slowly and regularly towards back. Axis strongly arched transversely. Axial rings flattened longitudinally. Articulating furrow deep, articulating half-ring long. A long, broad-based rounded median spine on eighth segment is directed strongly backwards. Axial furrows deep. Pleuræ less than one-third width of axial rings, posterior pleuræ narrower and curved more backwards than anterior. Articulating bosses and sockets small but strong. Pleural furrows broad, oblique. Doublure convex, extending to axial furrows.

Pygidium subquadrate, wider than long. Axis short and swollen, two-thirds width of pygidium. Anterior ring short, expanding at sides; posterior ring represented by a pair of obliquely elongated lobes, a little apart. Articulating bosses at antero-lateral extremities of pygidium. Both pairs of pleuræ end in short, sub-triangular free points; anterior pair terminate in advance of, or in line with, posterior pair. Median notch moderately deep and wide, variable in shape. Pleural and interpleural furrows absent. Doublure convex, undercutting axis slightly.

Glabella coarsely tuberculate posteriorly and laterally, may be finely tuberculate elsewhere.

Occipital and thoracic rings tuberculate, a row of larger tubercles along posterior margins. Terrace lines on doublure shallow and closely spaced.

Remarks.—*R. procax* resembles *R. cœlatus* Whittington (1959, pp. 401–411, pl. i–iii; pl. iv, figs. 1–25; text-figs. 4, 5) from the Lower Edinburg Formation in the prominent tongue and long subgenal spines, but differs in ornamentation, outline of the pygidium, and other features. In most specimens from Minuntion the tongue is less convex and is bent more strongly downwards than is the case at Bougang (Pl. I, fig. 5), but in other respects the material from the two localities is similar.

Remopleurides sp.

(Pl. I, figs. 9–17)

Material.—1 dorsal shield, 17 cranidia, 16 free cheeks, 9 hypostomes, 40 thoracic segments and 10 pygidia from Kirkdominæ; one free cheek and one incomplete thorax and pygidium from Minuntion.

Material from other horizons.—All parts from the top Stinchar Limestone, Auchensoul, and *superstes* Shales, Aldons.

Description.—Glabella much wider than long, moderately convex in both directions, greatest width far back. Anterior tongue narrow, short, weakly convex transversely, bent sharply downwards. Palpebral lobes narrow, not extending beyond base of tongue. Eye long, external rim of eye lobe marked off by broad furrows. Outer area of cheek broad, gently convex, narrowing steadily forwards. Posterior borders swollen proximally, merging with cheek laterally; posterior border furrow deep proximally, branching off from outer eye rim furrow, dying out in a short distance. Genal angle rectangular; librigenal spine not developed. Doublure of free cheek extends inwards to eye, broad and flattened posteriorly; a shallow, smooth, forwards-facing ledge curves forwards and outwards across hind part of doublure; anterior to ledge doublure deepens abruptly becoming convex opposite mid-length of eye, shallowing rapidly anteriorly and extending, with moderate convexity, beneath tongue to the median suture. Stout elongated conical pit at mid-width of doublure opposite fossula; a broad depression curves backwards and inwards from pit to posterior inner angle of doublure. Inner margin of doublure straight beneath tongue, curling increasingly strongly upwards posterior to conical pits.

Hypostome moderately convex transversely, much wider than long. Middle body separated from anterior border by broad border furrow on internal mould which is hardly distinguishable on external mould; lateral and posterior border furrows deep and broad. Middle body transversely oval, not bilobate. Paired oval areas small, indistinctly defined, occupying about half width of middle body at mid-length, long axes strongly oblique. Median boss elongated, with steep anterior slope, much more conspicuous on internal than on external moulds. Anterior border broadly rounded in outline. Anterior wings large and parallel-sided, projecting dorsally upwards. Lateral and posterior borders moderately wide; lateral borders elevated near front. Postero-lateral forks directed straight backwards, about equal to median length of posterior border, broad-based and tapering rapidly; laterally forks slope steeply outwards, rounded in outline (Pl. I, fig. 14*b*). Sinuous raised lines parallel to margins on lateral and posterior borders, broadly V-shaped on middle body between smooth oval areas; internal moulds smooth, except for oval areas which are closely striate longitudinally.

Thorax composed of eleven segments, narrowing rapidly and evenly backwards. Axial rings gently convex longitudinally, strongly arched transversely; slender median spine at back of eighth ring. Pleuræ approximately one-third width of axial ring, broader in larger specimens; pleuræ of anterior seven and posterior four segments graduated in size, former considerably larger than latter series, tips of seventh pleuræ extending backwards at least as far as tips of eighth; enrolment often strongest between seventh and ninth segments. Doublure of each pleura gently convex longitudinally, flattened transversely, extending to axial furrow.

Pygidium less than half as long as wide. Anterior ring obsolete mesially, represented by a pair of lobes which expand laterally. Posterior ring consists of a pair of obliquely elongated lobes, separated by a median depression. Articulating bosses small; pleural areas gently convex. Both pairs of pleuræ end in short, blunt free points, in line, with shallow indentations between the pairs, and a deep ∩-shaped notch between the inner two. Pleural and interpleural furrows absent. Doublure deep, broad, curling upwards along inner margin, undercutting axis slightly.

Glabella with scattered tubercles at back; free cheeks with longitudinal raised lines. Surface of occipital ring, thorax and pygidium bearing anastomosing raised lines, running sub-parallel to margins; a row of tubercles along posterior margin of thoracic rings. Thoracic and occipital rings tuberculate on internal moulds, tubercles occasionally appear on external surface also. External surface of doublure with exceptionally deep, widely-spaced terrace lines.

Remarks.—Thoraces and pygidia from the Stinchar Limestone, Minuntion, collected by Mrs Gray and John Smith agree closely with this form, but associated cranidia differ in their greater length, and broader tongue.

There is a close resemblance between this species and *R. eximius* Whittington (1959, pp. 424–426, pls. xiv–xvi?) from the Lower Edinburg Limestone in all parts of the exoskeleton. *R. eximius* differs in the outline of the glabella, the short librigenal spines, the elongated seventh thoracic pleuræ, the median projection on the doublure of the pygidium and the sparser lineation and tuberculation. *R. asperulus* Whittington (1959, pp. 420–424, pls. xii, xiii) from the Upper Lincolnshire Limestone is similar also.

This species is allied also to *R. girvanensis* Reed (1903, pp. 39–41, pl. vi, figs. 8–15) from the Balclatchie Group, in the absence of librigenal spines, and in the outline of the pygidium.

Genus *Robergia* Wiman 1905

Robergia sp.

(Pl. I, figs. 18–19)

Material.—2 free cheeks, and 1 pygidium from Kirkdominæ.

Description.—Eye short, sloping steeply outwards, broad (tr.). External rim of eye lobe narrow, separated from eye by a narrow furrow and from cheek by a broad one. Outer area of cheek narrow. Posterior border marked off by a broad furrow. Subgenal notch broad, as deep as posterior border. Subgenal spine long, broad-based and commencing near mid-length of eye, directed at first obliquely outwards and backwards, curving backwards posteriorly. Doublure of cheek and spine convex; conical pit in doublure large. A broad depression runs from pit to median suture, parallel to posterior margin of doublure.

Pygidium subquadrangular in outline, longer than wide. Axis three-fifths maximum width of pygidium anteriorly, tapering steadily to narrowly pointed apex on posterior margin, moderately arched transversely. Axial furrows faint. First ring faintly defined; first ring furrow deeper laterally than mesially. Pleural lobes slope gently outwards. First interpleural furrow distinct, curving outwards and backwards, dying out posteriorly, marking off a narrow pleura. Subsequent segments indistinguishable. Posterior margin gently arcuate, with four pairs of short spines, directed outwards.

Remarks.—Only one other species is recorded as having four pairs of spines on the posterior margin of the pygidium—*Robergia schlotheimi* (Billings) (Raymond 1925, p. 59), and in that species the axis is only about half the length of the pygidium. Another unusual feature is the long, divergent subgenal spine, in the Kirkdominæ form.

Family ASAPHIDÆ Burmeister 1843

Genus *Isotelus* DeKay 1824

Isotelus stincharensis (Begg 1950)

(Pl. I, figs. 20–25)

Asaphus sp. Reed 1904, p. 49, pl. vii, fig. 9.

Homotelus stincharensis Begg 1950, p. 288, pl. xiv, figs. 4, 5.

Diagnosis.—Cranidium narrow anteriorly; axial furrows extend to anterior extremities of eyes. Eye small, placed far forwards. Librigenal angles sharply rounded. Pygidium semicircular, axis well defined only at posterior end.

Holotype.—GSM 88880 (pygidium). Pl. I, fig. 24. Minuntion.

Paratype.—GSM 88881 (pygidium). Minuntion.

Other material.—1 dorsal shield, 2 cephala, and numerous isolated parts from Minuntion.

Material from other horizons.—[1 hypostome from the Stinchar Limestone, Minuntion.]

Dimensions.—

	BM In.21594	A.5252
Median length of cephalon	22·2 mm.	17·8 mm.
Width of cephalon	41·8 mm.	34·0 mm.
Maximum width of cranidium anterior to eyes	18·6 mm.	17·0 mm.
Width of cranidium at posterior margin .	32·4 mm.	28·5 mm.

Description.—Cephalon subparabolic in outline, short anterior to eyes, flattened longitudinally, cranidium gently convex transversely, cheeks steeply inclined. Glabella undefined anteriorly, moderately arched and almost parallel sided posteriorly. Axial furrows broad and shallow, dying out opposite anterior extremities of eyes, apodemes at posterior margin. Palpebral lobes small, concave, sloping inwards. Anterior branches of facial sutures diverge only slightly from eyes, bending inwards sharply, and meeting at a low angle on anterior margin of cephalon; posterior branches run in sigmoidal courses, curving increasingly strongly backwards posteriorly.

Eye small, mid-length situated at about two-fifths length of cranidium from back, of moderate height, separated from cheek by a broad furrow. Free cheek moderately wide, curved strongly downwards at sides, extending backwards beyond cranidium, genal angle rounded. Doublure extends for almost half length of cephalon mesially, narrowing laterally; inner margin curved dorsally upwards, deep, swinging backwards a short distance outside eye; deep vincular notch situated at about its own length from posterior margin, posterior to which doublure lies close to dorsal surface. Panderian protuberance rounded, shallow. Terrace lines widely spaced.

[Hypostome subrectangular in outline. Anterior margin transverse. Middle body and maculæ not developed. Lateral margins gently convex outwards. Posterior forks broad. Posterior notch rounded, extending for two-fifths length of hypostome. Posterior doublure three-fifths length of hypostome, strongly convex and keeled longitudinally below forks, with deep, rounded protuberances opposite mid-length of hypostome. Ventral surface closely striate longitudinally, doublure almost smooth.]

Thorax composed of eight segments, weakly convex transversely. Axis only slightly more than one-third width of thorax, narrowing slowly towards back, flattened longitudinally, gently arched transversely. Articulating furrows shallow, small apodemes at lateral extremities. Axial furrows shallow but distinct. Pleuræ straight and horizontal proximally, bent strongly backwards and downwards near one-third width; extremities truncate. Pleural furrows broad and straight, dying out just beyond fulcrum. Articulating facets strongly developed, particularly on anterior segments.

Pygidium parabolic in outline, gently convex longitudinally and transversely. Axis moderately broad anteriorly, tapering steadily to a narrow, raised apex at one-fifth length of pygidium from back, ill defined except at apex. Pleural lobes gently convex, without indication of pleuræ, post-axial area very gently concave on external surface; anterior lateral angles swollen, marked off by broad grooves, obliquely truncated by articulating facets. Doublure reaches almost to apex of axis posteriorly, widening slightly anteriorly, flattened distally, upturned proximally; terrace lines faint, closely spaced, running parallel to margins.

Remarks.—*I. stincharensis* bears some resemblance to *I. instabilis* (Reed 1904, p. 46, pl. vii, figs. 2–8) from the Balclatchie Group; it differs in its weaker convexity, in the more forward position of the eyes, and in lacking librigenal spines.

Isotelus sp.

(Pl. I, fig. 26)

Material.—1 cranidium and 1 pygidium from Minuntion.

Description.—Cranidium short, convexity weak in both directions. Glabella undefined. Palpebral lobes large, flattened, situated far back. Anterior branches of facial sutures diverge strongly from eyes, bending inwards sharply.

Pygidium (A.5219) convex. Axis broad, tapering steadily backwards. Posterior part defective.

Genus *Homotelus* Raymond 1925

Homotelus sp.

(Pl. I, figs. 27, 28)

Material.—1 cranidium and 2 pygidia from Bougang.

Description.—Cranidium short, markedly convex in both directions. Glabella broad posteriorly, narrowing forwards, widening anterior to eyes, gently arched transversely. Axial furrows broad and moderately deep; apodemes at posterior extremities. Palpebral lobes large, sloping inwards, placed opposite mid-length of cranidium. Anterior branches of facial sutures meet at a very low angle.

Broad pygidium (Pl. I, fig. 28) twice as wide as long; axis almost indistinguishable. Doublure short, strongly concave proximally. Narrower pygidium (GSE 11885) has the axis more distinct.

Homotelus ? sp.

Material.—1 free cheek from Kirkdominæ.

Description.—Eye (not preserved) anterior to mid-length of cranidium; posterior branch of facial suture runs strongly outwards. Doublure comparatively short, and convex anteriorly, apparently with a truncate median elongation; inner margin swings backwards close to eye, narrowing backwards, becoming concave at postero-lateral angles, just anterior to which a vincular notch is situated.

Remarks.—The eye-scar is smaller and further forwards than would have been the case in the preceding species. The reference of the specimen to this genus is tentative.

Family STYGINIDÆ Vogdes 1890

Genus *Raymondaspis* Přibyl 1948

Raymondaspis hermaion n.sp.

(Pl. II, figs. 1–3)

Diagnosis.—Glabella slopes strongly downwards, with moderate convexity; posterior width four-sevenths that of frontal lobe. Anterior border lacking.

Holotype.—A.5341a, b (cranidium). Pl. II, figs. 1*a*–*c*. Kirkdominæ.

Other material.—3 cranidia from Kirkdominæ.

Dimensions.—

	Holotype	A.5269a, b
Length of cranidium	3·0 mm.	2·5 mm.
Length of glabella	2·5 mm.	2·2 mm.
Basal width of glabella	1·1 mm.	0·8 mm.
Anterior width of glabella	2·1 mm.	2·0 mm.

Description.—Cranidium broadly rounded in outline, moderately convex longitudinally, sloping steeply to very steeply downwards. Glabella narrow and parallel sided posteriorly, expanding gradually towards front, and extending to anterior margin; transverse convexity moderate. Occipital ring long mesially, narrowing rapidly laterally. Axial furrows narrow, deeper posteriorly than anteriorly, bending strongly inwards and dying out at forefront. Fixed cheeks broad, gently convex posteriorly. Palpebral lobes two-fifths length of glabella, posterior extremity opposite occipital furrow. Posterior borders short, depressed. Surface smooth.

Remarks.—*R. hermaion* appears to be a borderline species between *Raymondaspis* and *Stygina*; it resembles *R. limbata* (Angelin), the type species, in having the eyes placed well away from the axial furrows, but it lacks the preglabellar area.

Genus *Kirkdomina* n.gen.

Diagnosis.—Glabella narrow and elongate, devoid of furrows, circumscribed. Anterior border long (sag.), slightly upturned. Anterior branches of facial sutures run parallel to and moderately close to axial furrows. Eyes small, placed close to glabella and about their own length from posterior margin.

Type species.—*Kirkdomina williamsi* n.sp.

Remarks.—The narrow, circumscribed glabella and upturned anterior border readily distinguish this genus from *Stygina* Salter.

Kirkdomina williamsi n.sp.

(Pl. II, figs. 4–5)

Diagnosis.—Glabella parallel sided posteriorly, widening little anteriorly, moderately convex longitudinally.

Holotype.—A.5270a, b. (cranidium). Pl. II, figs. 4*a*, *b*. Kirkdominæ.

Paratype.—A.5271a, b (cephalon). Kirkdominæ.

Dimensions of holotype.—

Length of cranidium . . .	1·8 mm.
Length of glabella . . .	1·4 mm.
Width of glabella at front . .	0·8 mm.
Width of glabella at back . .	0·6 mm.

Description.—Cephalon semicircular, strongly convex in both directions, with short librigenal spines. Glabella narrow and elongate, moderately convex in both directions; anterior angles strongly rounded; anterior three-sevenths slightly wider than posterior part and less strongly convex transversely; posterior part almost parallel sided; glabellar lobes and furrows lacking. Glabella sharply defined by preglabellar and axial furrows, anterior part standing above fixed cheeks and preglabellar field. Occipital ring short, sloping gently forwards, slightly wider than glabella at back, strongly arched transversely. Occipital furrow deep and broad. Preglabellar field short, curving slowly upwards from the bottom of the preglabellar furrow to the short, slightly swollen anterior border. Fixed cheeks continuous with preglabellar field and flattened anteriorly, sloping steeply inwards in the proximity of palpebral lobes. Palpebral lobes three-tenths length of glabella, situated about their own length from posterior margin, not rising nearly as high as glabella. Posterior borders weak, depressed below cheeks; posterior border furrows shallow, widening laterally. Anterior branches of facial sutures long, running forwards in gentle curves parallel to axial furrows; posterior branches short, directed outwards and backwards.

Eye small, strongly rounded; lens surface convex, vertical. Free cheek convex, sloping steeply outwards. Lateral border not developed. Posterior border expands gradually laterally; posterior border furrow broad. Librigenal spine short, broad-based, continuing curve of lateral margin.

Remarks.—The only other species which appears to be referable to *Kirkdomina* is that described as *Philippsinella* [sic] *borealis* by Kummerow (1927, p. 13, pl. i, figs. 7, 8). The specimens are preserved in the museum of the Geologisch-Paläontologisches Institut of the University of Eastern Berlin, and thanks to the courtesy of Dr K. Diebel, they have been sent on loan to the British Museum. The cranidium agrees in all essential features with the Kirkdominæ species, though the longitudinal convexity is stronger, and the glabella tapers towards the back. The pygidium is disproportionately large, but it is of styginid type. If the specimens are indeed from a Lower Red Orthoceras Limestone erratic, as recorded, and therefore of Arenig age, then further evidence is necessary before the two species can be certainly considered as congeneric.

Family Scutelluidæ R. and E. Richter 1955

Genus *Eobronteus* Reed 1928

Eobronteus latus n.sp.

(Pl. I, figs. 29–32)

Diagnosis.—Cranidium broad; glabella parallel sided posteriorly; axial furrows faint anteriorly; anterior border furrow deep.

Holotype.—A.5266a, b (cranidium). Pl. I, figs. 29*a–c*. Kirkdominæ.

Paratype.—A.5268a, b (hypostome). Kirkdominæ.

Other material.—4 cranidia. Kirkdominæ.

Dimensions.—

	Holotype	A.5267a, b
Length of cranidium	2·4 mm.	3·3 mm.
Maximum width of cranidium	5·2 mm.	5·5 mm.
Width of glabella at base	1·5 mm.	2·0 mm.
Maximum width between eyes	4·1 mm.	. .

Description.—Cranidium subsemicircular in outline, sloping forwards with weak convexity. Glabella parallel sided posteriorly, widening abruptly just anterior to mid-length, and becoming ill defined, extending to anterior border furrow; moderately arched posteriorly. Lateral glabellar furrows not distinguishable. Occipital ring short, equal to base of glabella in width; occipital furrow narrow, transverse. Axial furrows deep and narrow posteriorly, faint anteriorly, bending sharply inwards at anterior lateral angles of glabella, and joining anterior border furrow. Anterior border narrow, swollen, convexity continuous with that of doublure, marked off both from glabella and from cheeks by a border furrow, which widens laterally. Fixed cheeks broad opposite eyes, sloping inwards and backwards posteriorly. Elliptical paraglabellar areas situated about their own length anterior to posterior border furrows. Shallow intramarginal furrows run parallel to border, joining axial furrows just behind antero-lateral angles of glabella. Palpebral lobes large, flattened, situated well back. Anterior branches of facial sutures run forwards and outwards with decreasing divergency; posterior branches run backwards and outwards. Cranidial surface with shallow striæ arranged in Bertillon pattern; striæ on posterior and antero-median part of glabella, and on occipital ring, concentric to posterior; striæ on antero-lateral parts of glabella and on fixed cheeks, concentric to palpebral lobes.

Hypostome subrectangular, as long as wide; anterior wings small. Middle body convex, rounded posteriorly. Lateral lobes one-third length of middle body, triangular, swollen, with smooth, elliptical maculæ at anterior angles. Lateral and posterior furrows deep and broad. Lateral borders convex anteriorly, narrowing backwards; posterior border rounded, flattened.

Surface with widely spaced terrace lines, arranged in V-pattern on middle body, parallel to margin on borders.

Remarks.—*E. latus* bears some resemblance to *E. slocomi* (Bradley) (see Sinclair 1949, pp. 48–50, pl. xii, figs. 1–4, 7–11) from the Kimmswick Limestone, particularly in surface markings. It differs chiefly in the shallowness of the axial furrows anteriorly, and the greater depth of the anterior border furrow. The latter feature is a point of similarity to *Eobronteus* sp. (Tripp 1954, pp. 668–669, pl. ii, figs. 27–29) from the Kiln Mudstones.

Family ILLÆNIDÆ Hawle and Corda 1847

Genus *Illœnus* Dalman 1827

Illœnus beggi n.sp.

(Pl. II, figs. 7–9)

Illœnus latus McCoy. Reed 1904, p. 63, pl. ix, figs. 6, 7.

Diagnosis.—Dorsal shield broad, strongly convex longitudinally. Glabella moderately wide, axial furrows slightly convergent. Axis of pygidium subrectangular in outline; anterior margin of doublure with a pair of short subsidiary cusps near mid-line.

Holotype.—A.5199 (cranidium). Pl. II, figs. 7*a–c*. Minuntion. Begg Collection.

Paratype.—A.5245 (pygidium). Minuntion.

Other material.—Cranidia and pygidia from Minuntion.

Material from other horizons.—Cranidia, thorax and pygidia from the Stinchar Limestone, Minuntion.

Dimensions of holotype.—

Length of cranidium	16·8 mm.
Width of cranidium (estimated) . .	24·0 mm.
Length of palpebral lobe . . .	3·0 mm.
Width of glabella at base . . .	10·4 mm.

Description.—Cranidium broad, strongly convex longitudinally, weakly so transversely. Glabella moderately wide, arched transversely and rising well above cheeks. Axial furrows short and broad, converging at first, then sub-parallel; a pair of small apodemes at posterior extremities. Fixed cheeks broad, curving strongly downwards at back, moderately arched transversely. Palpebral lobes short, placed near posterior margin, horizontally extended. Anterior branches of facial sutures run almost straight forwards, curving inwards at front; posterior branches run obliquely outwards and backwards.

Number of thoracic segments unknown. Axis of thorax broad, evenly arched. Axial furrows weakly defined. Pleuræ flattened longitudinally, approximately equal to axis in width, bent strongly downwards and slightly backwards at mid-width. Doublure extends to fulcrum.

Pygidium four-sevenths as long as wide, longitudinal convexity strong but somewhat variable, transverse convexity weak. Axis slightly less than half length, one-third anterior width of pygidium, sub-rectangular in outline, swollen. Axial furrows broad, sub-parallel at first, bending strongly inwards and truncating axis. Antero-lateral angles oblique; posterior margin gently rounded. Doublure long, concave, with a broad, longitudinal median channel; anterior margin of doublure projects in a pair of cusps slightly less than one-third width of pygidium apart; median embayment shallow, with a pair of short subsidiary cusps near mid-line. A few terrace lines run sub-parallel to anterior margin, becoming more widely spaced and convergent backwards posteriorly.

Remarks.—*I. beggi* differs markedly from *I. latus* McCoy (1849, p. 404; 1854, p. 172, pl. iE figs. 17, 17 a) from the Wræ Limestone, in its stronger longitudinal convexity and broader glabella. The affinities of *I. beggi* lie with the *I. americanus* species group, amongst which *I. grœnlandicus* Troedsson (1928, pp. 36–38, pl. xiii, figs. 8–18) may be specially mentioned.

Illænus devexus n.sp.

(Pl. II, figs. 10*a*–*c*)

Diagnosis.—Cranidium elongate, bent strongly downwards near back, longitudinal convexity weak anteriorly. Glabella moderately wide, flattened transversely.

Holotype.—GSE 11881 (cranidium). Pl. II, figs. 10*a*–*c*. Bougang.

Dimensions of holotype.—

Length of cranidium	22·3 mm.
Width of cranidium (estimated) . .	26·4 mm.
Length of palpebral lobe . . .	4·8 mm.
Width of glabella at base . . .	13·7 mm.

Description.—Cranidium elongate, bent strongly downwards about one-third length from back, weakly convex anteriorly, gently arched transversely anterior to eyes, flattened posteriorly. Glabella moderately wide, flattened transversely. Axial furrows broad and moderately deep posteriorly, converging for a short distance, becoming shallower and running sub-parallel, dying out before mid-length of cranidium; a pair of small, subcircular apodemes at posterior extremities. Fixed cheeks narrow, weakly convex, rising as high as glabella. Palpebral lobes long, gently rounded in outline, sloping outwards, situated near posterior margin. Anterior branches of facial sutures diverge from eyes for about half their length, curving round and converging strongly at anterior margin. Posterior branches run backwards and strongly outwards. Dorsal surface smooth except for anterior part of cranidium, which bears a few terrace lines.

Remarks.—The species with which *I. devexus* can be most closely compared is *I. depressicapitatus* Bradley (1930, pp. 252–253, pl. 28, figs. 11–14) from the Kimmswick Limestone. Our species differs in having the glabella flattened but not depressed, the axial furrows curve less strongly inwards, and the eyes are larger.

Illænus spp.

(Pl. II, figs. 11–14)

Material.—Cranidia, free cheeks, and pygidia, from Bougang and Kirkdominæ.

Description.—At least two other species of *Illænus* occur in the *confinis* Flags. A cranidium and free cheek from Bougang possess strongly elevated eyes (Pl. II, fig. 11). From Kirkdominæ there is a cranidium with narrow glabella and axial furrows bowed inwards. There are two types of free cheeks from Kirkdominæ, both with large eyes placed well back; one (Pl. II, fig. 12) has a wide posterior border and short librigenal spine; the other (Pl. II, fig. 13) has the genal angle rounded and the doublure broad, with a concave border marked off by a shallow furrow running parallel to margin from convex inner area. A pygidium (Pl. II, fig. 14) from Kirkdominæ with broad axis, faint axial furrows, and short convex doublure, anterior margin entire, is of interest as belonging to Jaanusson's *Parillænus* species-group.

Genus *Stenopareia* Holm 1886

Stenopareia sp.

(Pl. II, fig. 6)

Material.—3 cranidia and 2 hypostomes from Kirkdominæ.

Remarks.—Certain poorly preserved cranidia with small eyes situated some way from posterior margin, and 2 hypostomes appear to belong to *Stenopareia* rather than *Illænus*.

Family PRŒTIDÆ Salter 1864

Genus *Prœtidella* Bancroft 1949

Prœtidella sp.

(Pl. II, fig. 15)

Material.—1 cranidium from Kirkdominæ.

Description.—Cranidium broadly rounded in outline, convexity weak. Glabella broadly rounded in front, as long as wide, gently convex. Lateral glabellar furrows obsolete. Occipital ring long mesially, narrowing steadily laterally, transversely arched more strongly than glabella; no occipital tubercle. Occipital furrow narrow, transverse. Preglabellar and axial furrows sharp. Anterior border slopes gently upwards, separated by a broad depression from convex preglabellar field. Palpebral lobes narrow, half length of glabella, extending back to occipital furrow. Surface smooth.

Remarks.—This specimen has the characteristic preglabellar area of *Prœtidella*, but differs from the type species, *P. fearnsidesi* Bancroft (1949, pp. 304–305, pl. x, fig. 23) in the narrower glabella and absence of basal glabellar furrows.

Family OTARIONIDÆ Richter and Richter 1926

Genus *Otarion* Zenker 1833

Otarion sp. A

(Pl. II, fig. 16)

Material.—7 cranidia from Kirkdominæ.

Description.—Cranidium geniculate. Glabella narrowly rounded anteriorly, broad and truncate posteriorly, moderately convex in both directions. Central lobe narrows little between basal lobes. Basal lobes short and broad, projecting sideways beyond central lobe. Occipital ring moderately arched transversely, with occipital tubercle. Preglabellar and axial furrows sharp. Anterior border short, horizontally extended. Anterior border furrow narrow. Preglabellar field moderately long, steeply inclined, continuous with fixed cheeks. Surface tuberculate, except for anterior border, which is smooth.

Remarks.—This species is strongly characterized by the width of the base and narrowness of the front of the glabella; the basal lateral glabellar lobes are small.

Otarion sp. B

(Pl. II, fig. 17)

Material.—2 cranidia from Kirkdominæ.

Description.—Cranidium longitudinally geniculate. Glabella elongate, oval, swollen. Basal lobes small, placed on lateral slopes of glabella, indenting central lobe only slightly. Preglabellar and axial furrows deep and broad; basal lateral furrows more shallow. Occipital ring narrow (tr.); occipital furrow very shallow. Anterior border flattened, moderately long, horizontally extended. Anterior border furrow deep and narrow. Preglabellar field considerably longer than anterior border, sloping steeply downwards with strong convexity, continuous with fixed cheeks. Palpebral lobes moderately large, situated comparatively close to glabella, opposite points of origin of basal furrows. Posterior borders short, depressed, transverse. Glabella weakly tuberculate. Anterior border smooth. Preglabellar field and fixed cheeks strongly tuberculate; preglabellar field shallowly pitted at front.

Remarks.—This species is allied to *O. beggi* Tripp (1954, p. 670, pl. iii, figs. 5–6) from the Kiln Mudstones, and to *Otarion* sp. (Lamont 1935, p. 324, pl. viii, figs. 6–7, text-fig. 4 b) from the Drummuck Group, in its elongate glabella and sloping basal lateral lobes, but the central lobe is much less inflated.

Otarion sp. C

(Pl. II, figs. 18*a*, *b*)

Material.—4 cranidia from Kirkdominæ.

Description.—Cranidium slopes steadily downwards towards front. Glabella broadly rounded anteriorly, truncate posteriorly, moderately convex in both directions. Central lobe narrows steadily between basal lobes. Basal lobes nodular, projecting laterally beyond central lobe. Occipital ring short. Preglabellar and axial furrows sharp. Basal lateral furrows shallower, broad at back. Anterior border short, horizontally extended. Anterior border furrow weakly defined. Preglabellar field long, gently convex. Palpebral lobes small, placed comparatively near glabella. Posterior borders short, depressed. Surface finely tuberculate, except for anterior border, which is smooth.

Remarks.—There is a close resemblance between species C and "*Otarion*" *tenuis* Kielan (1959, pp. 63–64, pl. ii, figs. 1–2, text-fig. 15) from the *Staurocephalus clavifrons* zone, Poland; both species possess a long preglabellar field.

Family RAPHIOPHORIDÆ Angelin 1854

Genus *Ampyx* Dalman 1827

Ampyx harperi n.sp.

(Pl. II, figs. 19*a*, *b*)

Diagnosis.—Central lobe of glabella swollen, indented by lunate basal muscle areas. Lateral glabellar areas broad, clearly defined proximally, not distinctly marked off from fixed cheeks.

Holotype.—A.5225 (external mould of cephalon). Pl. II, figs. 20*a*, *b*. Minuntion. Collected by Dr J. C. Harper. This is the only specimen known.

Dimensions of holotype.—

Length of cranidium to base of spine . .	9·5 mm.
Width of cranidium	18·2 mm.
Width of glabella across frontal lobe . .	6·7 mm.
Width of glabella between basal muscle areas	2·6 mm.
Length of occipital ring	1·2 mm.

Description.—Cephalon triangular, with straight anterior and librigenal spines, latter strongly divergent. Glabella subpentagonal, moderately convex, rising well above cheeks; anterior part narrowing rapidly and projecting beyond cephalic margin. Anterior spine arises abruptly, slender, straight, inclined slightly upwards, rounded in cross-section, full length unknown. Central lobe much more strongly swollen than lateral glabellar areas; greatest width at one-third length from front. Longitudinal glabellar furrows converge and become better defined towards back. Basal lateral muscle areas (Whittington's first pair) lunate, indenting central lobe. Other muscle areas hardly distinguishable. Lateral glabellar areas broad, extending for about half length of glabella, convexity only slightly different from that of fixed cheeks. Axial furrows almost obsolete for most of their length, bowed gently outwards, converging slowly backwards. Occipital ring convex, sloping forwards, curved weakly backwards in outline, continuous with posterior borders. Occipital furrow well defined. Cheeks become increasingly convex towards sides, courses of facial sutures not visible. Posterior borders convex, sloping more steeply forwards laterally. Posterior border furrows moderately broad, bending backwards and dying out near genal angles; distal pits faint. Librigenal spines slender, straight, inclined slightly upwards, directed backwards at sixty degrees to median line, more than twice length of glabella. Dorsal surface smooth.

Remarks.—The interpretation of this species is based on Whittington's description of *A. virginiensis* Cooper (Whittington 1959, pp. 465–473, pl. xxix; pl. xxx, figs. 1–14, 16, 17, 20–30; pl. xxxi; text-fig. 7). The lateral glabellar areas are more completely fused with the fixed cheeks in *A. harperi* than in any other species.

Genus *Lonchodomas* Angelin 1854

Lonchodomas tumidum n.sp.

(Pl. II, figs. 20*a*–*c*)

Diagnosis.—Glabella narrow, strongly swollen, non-carinate. Anterior spine curved only slightly upwards.

Holotype.—A.5217a, b (cranidium). Pl. II, figs. 20*a*–*c*. Minuntion.

Other material.—1 cranidium from Minuntion.

Dimensions of holotype.—

Length of cranidium to base of spine . .	5·5 mm.
Width of cranidium	8·1 mm.
Maximum width of glabella	2·9 mm.
Basal width of glabella	1·7 mm.
Length of occipital ring	0·5 mm.

Description.—Cranidium narrow, triangular. Glabella narrow, lozenge-shaped, strongly convex longitudinally and transversely, sloping steeply forwards and gently backwards from summit, projecting beyond cheeks for three-eighths its length; width greatest near mid-length, narrowing more rapidly anteriorly than posteriorly. Anterior spine stout at base, narrowing gradually, curved only slightly upwards and considerably longer than glabella; spine subquadrate in cross-section, ridges along upper edges continue parallel for a short distance on glabella. Axial furrows broad and shallow; anterior pits longitudinally elongate, situated just posterior to greatest width of glabella. Occipital ring flattened, sloping gently forwards, curved weakly backwards in outline, continuous with posterior borders. Occipital furrow broad and shallow. Fixed cheeks moderately convex, sloping steeply towards front. Posterior borders flattened, narrowing steadily laterally. Posterior border furrows become narrower distally. Courses of facial sutures sigmoidal, convex outwards at front, becoming convex inwards laterally, and bending round to cut posterior borders at steep angles. Dorsal surface finely and closely pitted.

Remarks.—This species can be compared with *L. politum* Raymond (1925, pp. 39–40, pl. ii, figs. 8–9; Cooper 1953, pp. 18–19, pl. vi, figs. 1–2, 5–10) from the "Upper Lenoir" Limestone. The strong convexity of the glabella distinguishes *L. tumidum.*

Family Cheiruridæ Salter 1864

Genus *Ceraurinella* Cooper 1953

Ceraurinella sp.

(Pl. II, fig. 21)

Material.—3 pygidia from Kirkdominæ.

Description.—Median length of pygidium about half the width. Three axial rings, of moderate convexity; ring furrows deep, apodemes at extremities of each. Axial furrows hardly defined. Anterior flanges moderately large, swollen. First pair of pleuræ greatly extended, tapering slowly, rounded, sloping upwards and backwards; pleural furrow very short and shallow. First interpleural furrow sharp proximally, dying out before margin. Second and third pleuræ small, ending in short, broad free points; pleural furrows obsolete; interpleural furrows short. Doublure narrow, sulcate mesially; inner margin rolled and sharply upturned. Dorsal and ventral surfaces granular.

Remarks.—These pygidia differ markedly from *Bartoninus* and correspond exactly with *Ceraurinella,* particularly in the slope of the first pair of pleuræ, and in the construction of the doublure.

Genus *Bartoninus* n.gen.

Diagnosis.—Glabella parallel sided or expanding moderately anteriorly. Basal lateral glabellar lobes about one-third width of glabella. Exoskeleton non-tuberculate; inner areas of fixed and free cheeks pitted. Posterior margin of hypostome transverse, without lateral denticles. Pygidium with first pair of pleuræ broad-based and moderately long, third pair short, second pair intermediate in size.

Type species.—*Bartoninus dispersus* n.sp.

Remarks.—Whittington (1954, p. 128) has recommended that, because of uncertainty regarding the holotype, the use of the name *Ceraurinus* Barton should be restricted to the type species, *marginatus* Barton. Most American species formerly included in *Ceraurinus* are now referred either to *Remipyga* Whittington or to *Ceraurinella* Cooper. Four British species are distinguished by having the pygidial pleuræ graduated in size, and upon this character the new genus *Bartoninus* is principally based. The four species are: the type species, *B. gelasinosus* (Portlock), *B. craigensis* (Tripp) and *B. keisleyensis* (Reed). *B. clasoni* (Törnquist) from the Kallholn Limestone of Sweden is allied to *B. keisleyensis*; *Cheirurus subulatus* (Linnarsson) from the *Tretaspis* Shales of Sweden stands closer to *Bartoninus* than to any other genus. The cranidia of these species differ particularly in the definition of the anterior border, which Warburg (1925, p. 340) considered an important feature, and in the shape of the glabella. It may, therefore, prove necessary to subdivide the group further.

Bartoninus dispersus n.sp.

(Pl. II, figs. 22–32)

Diagnosis.—Glabella widest across frontal lobe; anterior and middle lateral furrows short; anterior border weakly developed. Anterior flanges of pygidium produced into short, outwardly directed spines.

Holotype.—A.5209a, b (cephalon). Pl. II, figs. 22*a*, *b*. Minuntion.

Paratypes.—A.5277a, b (hypostome); Kirkdominæ. A.5311 (thoracic segment); Minuntion. A.5312 (pygidium); Kirkdominæ.

Other material.—Cranidia, free cheeks, hypostomes, thoracic segments and pygidia common at Kirkdominæ, less frequent at Minuntion, Benan Burn, Auchlewen Burn and Bougang.

Material from other horizons.—2 cranidia from the Stinchar Limestone, Minuntion.

Dimensions.—

	Holotype	A.5208a, b Minuntion
Median length of cranidium	12·0 mm.	13·4 mm.
Width of cranidium (estimated) . . .	24·2 mm.	31·0 mm.
Length of central lobe	11·0 mm.	11·0 mm.
Anterior width of glabella.	8·7 mm.	10·8 mm.
Basal width of glabella	7·9 mm.	10·1 mm.

Description.—Cephalon subsemicircular in outline, moderately convex; fixigenal spines stout and short. Glabella subrectangular, moderately convex posteriorly, more strongly convex anteriorly, evenly arched transversely. Frontal lobe moderately long, wider than rest of glabella; anterior outline almost transverse with sharp anterior-lateral angles in broad form, more broadly rounded in narrow form. Lateral lobes subequal in length, with some independent convexity; basal lobes quadrangular, circumscribed, about one-third basal width of glabella, not extending backwards far beyond central lobe. Anterior and middle lateral furrows sub-parallel, deep laterally, shallowing rapidly, slightly less than one-third width of glabella, directed inwards and slightly backwards; basal lateral furrows narrow and inclined backwards, deepening rapidly into blade-shaped apodemes; inner extremities connected to occipital furrow by broad depressions. Occipital ring narrows laterally, more strongly arched than glabella transversely; small occipital tubercle present. Occipital furrow broad and shallow mesially, narrowing laterally and deepening into blade-shaped apodemes near lateral extremities. Axial furrows deep and broad; shallow fossulæ just anterior to eye ridges. Anterior border short, continuing general convexity of glabella. Preglabellar furrow shallow, bowed slightly upwards mesially. Fixed cheeks broad, sloping away from glabella, weakly convex. Eye ridges short and strong, running obliquely outwards from cheek buttresses opposite anterior lateral furrows, to anterior extremities of palpebral lobes. Palpebral lobes small, raised, placed opposite middle lateral lobes, and close to axial furrows. Palpebral furrows start in shallow pits at mid-length of lobes and curve round posterior extremities of eyes. Posterior borders short and convex proximally, becoming steadily wider and flatter laterally, a strong articulating flange projecting backwards near mid-width. Posterior and lateral border furrows deep, meeting at right angles. Lateral borders broad and flattened. Fixigenal spines one-third length of cranidium, slender, directed strongly backwards. Anterior branches of facial sutures run forwards and inwards to anterior margin; posterior branches curve outwards and backwards, cutting lateral margins at low angles opposite posterior border furrows. Lateral doublure convex, moderately wide.

Eye moderately large, strongly rounded, bounded by a broad furrow; lens surface strongly convex, sloping steeply outwards; inner area of cheek weakly convex. Lateral border convex, approximately equal to inner area in width at mid-length, narrowing to form a flattened, inclined anterior extension. Border furrow deep and broad. Doublure almost as broad as border, convex.

Hypostome trapeziform, variable in proportions. Middle body obovate, strongly inflated. Posterior lobes well developed and moderately swollen, faintly connected on internal moulds only to form a V-shaped ridge. Lateral and posterior furrows broad and shallow throughout. Anterior border developed laterally. Anterior wings large, sloping steeply backwards and upwards; wing processes near lateral extremities. Lateral borders broad, sloping gently inwards anteriorly, narrowing steadily towards back; lateral margins convergent. Posterior border moderately long (sag.); posterior margin transverse. External surface closely and minutely granular; internal moulds of middle body coarsely tuberculate.

Number of thoracic segments not known. Axis strongly arched transversely; apodemes near extremities of articulating furrow. Axial and other furrows much deeper on internal than on external surface. Inner part of pleura one-third width of axis, marked off from outer part by a longitudinal furrow, inflated, divided by a deep, diagonal pleural furrow. Outer part narrows steadily to the tip, curving downwards. Fulcral articulating flanges and sockets strongly developed.

Pygidium slightly wider than long. Axis one-third anterior width of pygidium, narrowing slowly backwards, strongly arched transversely. First and second axial rings and furrows well developed. Third ring fused with third pleuræ; third ring furrow shallow. Terminal piece confluent with pleuræ. Axial furrows deep and narrow at front, shallowing opposite second ring. Anterior flanges strongly developed, produced into short, stout spines, directed almost straight outwards. First pleuræ narrow (sag.) and swollen at base, widening steadily to near mid-length, tapering distally, flattened, horizontally extended; free points extend backwards twice median length of pygidium. First pleural furrows deep and short. Second pleuræ narrow, connected to first pleuræ for only a short distance, marked off by deep interpleural furrows; free points intermediate between first and third in length. Free points of third pleuræ short and triangular, their inner margins meeting at an acute angle. Second and third pleural furrows obsolete. Doublure deep, broad, flattened, anterior margin gently convex in outline except for a deep median embayment, upturned along margin; a pair of obliquely elongated swellings opposite second pleuræ.

Surface minutely and densely granular. Fixed and free cheeks within borders coarsely and deeply pitted.

The wide range of variation in the proportions of the glabella (Pl. II, figs. 22*a* and 25) and the hypostome (Pl. II, figs. 27 and 28) is no more than indicated by the illustrations.

Remarks.—The weak definition of the anterior border of the cranidium immediately distinguishes this species from both *B. gelasinosus* and *B. craigensis.* The short spines on the anterior flanges are a unique feature of the pygidium.

Genus *Sphœrexochus* Beyrich 1845

Sphœrexochus eurys n.sp.

(Pl. III, figs. 1–7)

Diagnosis.—Glabella much wider than long, sloping gently downwards. Basal lateral glabellar furrows convergent and shallow proximally. Pygidium broad; axial furrows shallow opposite third ring; pleuræ short and broad. Surface granular.

Holotype.—A.5313 (cranidium). Pl. III, figs. 1*a–c*. Kirkdominæ.

Paratypes.—A.5279a, b (cephalon); A.5281a, b (hypostome); A.5278a, b (cranidium and thoracic segments); A.5312 (pygidium). Kirkdominæ.

Other material.—54 cranidia, 16 free cheeks, 5 hypostomes, 25 thoracic segments, 22 pygidia from Kirkdominæ.

Dimensions.—

	Holotype	A.5278a, b
Length of cranidium	3·6 mm.	4·1 mm.
Width of cranidium	5·0 mm.	5·5 mm.
Length of central lobe	3·4 mm.	3·8 mm.
Maximum width of glabella	4·3 mm.	4·5 mm.
Width of basal lateral lobes	1·6 mm.	1·6 mm.
Width of cheeks	1·4 mm.	1·5 mm.

Description.—Cephalon suboval in outline, cheeks steeply inclined. Glabella transversely oval, longitudinal convexity weak posteriorly strong and even anteriorly, moderately arched transversely, sloping gently downwards. Basal lateral glabellar lobes oval, slightly swollen. Posterior glabellar furrows curve inwards and backwards, inner extremities connected by convergent depressions, granular on external surface, to occipital furrow. Anterior and middle lateral furrows short, weakly impressed, placed well forwards. Occipital ring strongly arched transversely, narrowing and bowed backwards behind basal lateral lobes. Occipital furrow much broader mesially than laterally. Preglabellar and axial furrows deep and broad, undercutting glabella, fossulæ opposite anterior lateral furrows. Anterior border narrow widening laterally. Fixed cheeks moderately swollen posteriorly, narrowing anteriorly. Palpebral lobes small, elevated, placed opposite posterior lateral glabellar furrows. Palpebral furrows broad, not quite reaching anterior extremities of lobes. Posterior borders lengthen (sag.) laterally, continuous with lateral borders; margins of posterior and lateral borders convex, meeting at obtuse angles. Immature cranidia bear slender fixigenal spines, longest on smallest specimens. Posterior and lateral border furrows broad, continuous, curving forwards and increasing in width antero-laterally. Anterior branches of facial suture curve forwards and inwards parallel to axial furrows. Posterior branches curve backwards and outwards, cutting lateral margins near genal angles.

Eye small, convex, marked off by a shallow furrow. Inner area of free cheek swollen.

Lateral border moderately convex, widest near mid-length, strongly rounded in outline. Lateral border furrow extremely deep and broad, commencing closely behind anterior suture, continuous with, but considerably broader than, postero-lateral furrow. Doublure as wide as border, flattened; deep vincular notch at dorso-ventral margin just anterior to posterior suture.

Hypostome hexagonal, two-thirds as long as wide. Middle body weakly convex, transversely elongate. Lateral furrows inconspicuous. Anterior border short, developed laterally only, produced into dorsally upturned wings with notches behind. Lateral borders moderately wide and swollen, bending abruptly inwards near mid-length. Posterior border broad transverse. Lateral and posterior furrows broad, continuous.

Number of thoracic segments unknown. Axis strongly arched transversely. Rings strongly convex. Apodemes at extremities of articulating furrows. Axial furrows broad. Pleuræ narrow, strongly convex longitudinally, bent sharply downwards at fulcra, which are proximal to mid-width; pleuræ tapering laterally. Pleural furrows absent. Doublure convex, extending to fulcrum.

Pygidium arcuate in outline, length two-fifths width. Axis triangular, moderately arched transversely; first two rings broad, convex, defined by deep ring furrows. Third ring defined posteriorly by indentations at axial furrows, continuous with rounded subtriangular terminal piece. Articulating half-ring and furrow short. Axial furrows narrow, shallow opposite third ring. Three pairs of short, broad, swollen pleuræ, with short, blunt, free-ends. First two pairs widen little laterally; third pair widen markedly at back, extending little beyond axis and almost touching. Interpleural furrows shallow, first pair divergent, second pair sub-parallel. Doublure deep, broad and convex, steeply up turned at axis, antero-lateral margin almost straight.

External surface finely granular. Inner areas of cheeks shallowly and sparsely pitted.

Remarks.—The great width compared to length distinguish both the cranidium and the pygidium of *S. eurys* from other species, though the relative proportions are variable. Progressive reduction in length of fixigenal spines, similar to that which occurs in *S. eurys*, has been described in *S. pulcher* and *S. hapsidotus* by Whittington and Evitt (1954, pp. 87–95, pl. xvii, figs. 28–51; pl. xx; pl. xxi, figs. 1–4; pl. xxxii, figs. 6–35; pl. xxxiii; text-figs. 24–27). *S. eurys* differs significantly from both these species in that the lateral border furrows on fixed and free cheeks are continuous, and the posterior margin of the hypostome is not indented.

Genus *Sphærocoryphe* Angelin 1854

Sphærocoryphe saba n.sp.

(Pl. III, figs. 8–12)

Diagnosis.—Hinder part of glabella long, narrowing anteriorly; basal lateral lobes ill defined. Conical mounds situated mid-way between palpebral lobes and axial furrows.

Holotype.—A.5283a, b (cephalon). Pl. III, figs. 8*a–c*. Kirkdominæ.

Other material.—27 cranidia, [6 hypostomes]. Kirkdominæ.

Dimensions.—

	Holotype	A.5315
Median length of cranidium	4·1 mm.	. .
Width of anterior glabellar lobe	2·5 mm.	2·8 mm.
Width of glabella across basal lobes . . .	1·4 mm.	2·0 mm.

Description.—Bulbous anterior lobe of glabella spheroidal, projecting anteriorly, directed straight forwards, constricted all round base by a broad furrow. Hinder part of glabella long, depressed, narrowing anteriorly. Basal lateral lobes small, ill defined. Occipital ring short, strongly arched transversely. Occipital furrow broad. Axial furrows shallow at front, deepening rapidly, rounded fossulæ at junction with preglabellar furrow, apodemes at positions of posterior lateral glabellar furrows, and at extremities of occipital furrow. Preglabellar furrow deep and broad, curving only gently forwards and downwards. Anterior border narrow, convex, ventral in position. Fixed cheeks long (exsag.), transverse convexity weak proximally stronger laterally. Palpebral lobes moderately large, situated opposite back of bulbous lobe. Palpebral furrows broad and shallow. Cheeks drawn up into a pair of small conical mounds, midway between palpebral lobes and axial furrows. Posterior borders widen laterally; lateral borders broad. Posterior and lateral border furrows meet at an acute angle. A single short, broad-based lateral spine, directed straight downwards. Fixigenal spines comparatively short, strong, continuing in direction of lateral border, backwards and outwards. Anterior branches of facial sutures short, convergent; posterior branches curve strongly outwards.

Eye moderately large, overhanging anterior margin of free cheek. Free cheek small, sub-triangular, lateral border faintly developed. Front part of bulbous glabellar lobe granular, remainder usually tuberculate; occipital ring granular; inner areas of fixed cheeks closely and shallowly pitted.

[Hypostome subrectangular, slightly wider than long. Middle body ovate, swollen; lateral lobes not developed. Lateral and posterior furrows continuous, deep and broad. Anterior wings small, inclined dorsally upwards. Lateral margins strongly sigmoidal in outline. Lateral borders moderately broad, sloping steeply inwards anteriorly, becoming narrower and less steep posteriorly. Posterior borders broad, with short posterior spines at lateral extremities.]

Remarks.—The long fixed cheeks with the pair of conical mounds render this a distinctive species.

Sphærocoryphe sp. A

(Pl. III, figs. 13–14)

Material.—2 cranidia from Minuntion.

Description.—Cranidium wide, gently convex; fixigenal spines short, divergent. Bulbous glabellar lobe wider than long, weakly convex dorsally, contracted at base. Basal lateral lobes nodular, circumscribed, large. Preoccipital area depressed. Basal lateral glabellar furrows deep and broad, curving diagonally backwards to occipital furrow. Occipital ring long mesially, narrowing strongly behind basal lobes, moderately arched transversely. Occipital furrow broad mesially, becoming narrower and deeper laterally. Axial furrows deep anteriorly, shallow and narrow posteriorly. Fixed cheeks short and wide, curved downwards laterally. Palpebral lobes very large and elevated, overhanging narrow palpebral furrows, situated alongside bulbous lobe and anterior to its posterior extremity. Posterior borders short (sag.) proximally, expanding steadily laterally and curving gently backwards; posterior border furrows narrow, dying out laterally. Fixigenal spines stout, about one-third length of cranidium, directed outwards and backwards. Bulbous glabellar lobe pustulate posteriorly; remainder of cranidium granular.

Remarks.—The pustulate bulbous glabellar lobe and the large basal and palpebral lobes make this species unlike any other.

Sphœrocoryphe sp. B

(Pl. III, figs. 15–16)

Material.—10 cranidia from Kirkdominæ.

Description.—Bulbous glabellar lobe evenly convex, contracted at base. Basal lateral lobes subtriangular, convex. Axial furrows broad, shallow anteriorly, deepening abruptly just anterior to eyes, becoming shallow opposite basal glabellar lobes, deepening alongside occipital ring. Preglabellar furrow broad and shallow. Anterior border short, slightly concave in outline. Fixed cheeks large, convex; palpebral lobes some distance from glabella. Posterior borders depressed, widening laterally; border furrows narrow laterally. Cheek produced into a broad-based, blade-like fixigenal spine, directed strongly outwards and downwards, and slightly backwards. Eye convex, moderately large; outer area of free cheek gently convex to margin, narrowing slowly anteriorly and extending to lateral angle of anterior border, where suture cuts margin. Bulbous glabellar lobe tuberculate on postero-median area, and near preglabellar furrow; remainder of surface granular.

Remarks.—This species approaches *Hemisphœrocoryphe* in that the bulbous glabellar lobe reaches almost to the occipital furrow, there are no spines on the lateral borders, and the fixigenal spines are stout and divergent; it differs in the well defined basal glabellar lobes, and in the absence of middle and anterior lateral glabellar furrows.

Sphœrocoryphe sp. C

(Pl. III, fig. 17)

Material.—2 cranidia from Bougang.

Remarks.—This species somewhat resembles that from Kirkdominæ, but the bulbous glabellar lobe slopes downwards, and the fixigenal spines are slender and directed backwards.

Family Encrinuridæ Angelin 1854

Genus *Encrinuroides* Reed 1931

Encrinuroides autochthon n.sp.

(Pl. III, figs. 18–25)

Diagnosis.—Glabella considerably wider anteriorly than posteriorly, strongly swollen; antero-lateral angles sharply rounded. Lateral glabellar furrows weak. Fixigenal spines thorn like. Pygidium strongly convex longitudinally and transversely; seven or eight pairs of pleural ribs, of which only first four pairs reach lateral margin.

Holotype.—A.5286a, b (cranidium). Pl. III, figs. 18*a–c*. Kirkdominæ.

Paratypes.—A.5319 (free cheek); A.5288a, b (hypostome); A.5324 (thoracic segment); A.5289a, b (pygidium). Kirkdominæ.

Other material.—22 cranidia, 24 free cheeks, 11 hypostomes, 5 thoracic segments, 63 pygidia from Kirkdominæ.

Dimensions.—

	Holotype	A.5287a, b
Length of cranidium	2·8 mm.	4·7 mm.
Width of cranidium	7·4 mm.	8·0 mm.
Length of glabella	2·4 mm.	3·9 mm.
Width of glabella across frontal lobe	2·4 mm.	3·5 mm.
Width of glabella across basal lobes	1·4 mm.	1·7 mm.

Description.—Cephalon elliptical in outline, strongly convex in both directions; fixigenal spines small. Glabella subquadrate, narrowing steadily towards back, rising high above cheeks, strongly convex in both directions. Frontal lobe two-fifths length of glabella, broadly rounded in outline; longitudinal median furrow extends backwards from preglabellar furrow for one-quarter length of glabella, shallow posteriorly. Lateral lobes represented by swellings on lateral slopes of glabella, middle pair longest, posterior pair shortest. Lateral glabellar furrows short and broad. Occipital ring short, strongly arched transversely. Occipital furrow sharp, transverse. Axial furrows deep and narrow; stout apodemes proximally, at points of junction with middle and posterior lateral and occipital furrows; fossulæ at forefront. False preglabellar field extremely short, flattened, horizontally extended; preglabellar furrow deep and broad. Fixed cheeks convex, sloping steeply towards sides. Palpebral lobes small, sloping inwards, mid-length situated opposite middle lateral furrows and distant from glabella. Posterior borders short (exsag.), directed straight outwards. Posterior border furrows deep and broad. Laterally posterior borders widen and join short lateral borders; genal angles produced into thorn like fixigenal spines, pointing backwards and outwards. Anterior branches of facial sutures curve forwards and inwards from eyes, cutting axial furrows immediately anterior to fossulæ, and meeting in front of false preglabellar field; posterior branches curve outwards and backwards.

Eye lobe moderately large, elevated, separated from cheek by deep, broad furrow; lens surface convex, expanded, two-thirds height of lobe. Inner area of free cheek flattened, little wider than border opposite eye. Pseudoglabellar area short, indistinctly marked off from anterior border, which narrows out mesially. Lateral border continuous with anterior border, gently convex, bending strongly backwards posteriorly. Lateral border furrow deep and broad, confluent with axial and posterior border furrows. Doublure convex, as wide as border.

Hypostome subtriangular, variable in proportions, anterior outline strongly rounded. Middle body oval, three-quarters length of hypostome, strongly convex; longitudinal median lobe more strongly swollen on internal than on external surface, widening and dying out posteriorly. Oval maculæ faintly distinguishable on external moulds on postero-lateral slopes. Anterior border narrow and clearly marked off mesially, flexed upwards but ill defined laterally. Anterior wings large, sloping dorsally upwards; wing processes at mid-length near lateral margins. Lateral borders horizontally extended, increasing steadily in width posteriorly, produced into an acutely pointed tongue. Posterior lateral margins converge in gentle curves. Surface granular.

Number of thoracic segments unknown. Axial rings two-sevenths width of pleuræ, strongly arched transversely. Apodemes at extremities of articulating furrow. Axial furrows shallow. Pleuræ curve downwards near mid-width; swollen posterior rib short (exsag.), separated by a shallow furrow from short (exsag.) anterior band; extremities pointed.

Pygidium triangular, strongly vaulted, approximately as long as wide, composed of twenty or more axial rings, and seven or eight pairs of pleuræ. Axis narrow, markedly convex longitudinally and strongly arched transversely, narrowing slowly to an ill defined apex near posterior margin. Ring furrows well defined on internal moulds, becoming discontinuous posterior to eighth ring on external moulds. Axial furrows deep and broad anteriorly, fading out posteriorly. Pleural lobes narrow, sloping steeply outwards with weak convexity. Pleural ribs prominent; first four pairs end in short, outturned free points, subsequent ribs narrow out laterally. Pleuræ almost straight, successive pleuræ directed more strongly backwards. First four pairs of inter-pleural furrows deep and broad, subsequent furrows die out near lateral margin. Articulating facets moderately wide, obliquely truncating first pleuræ. Doublure narrow, sloping inwards and downwards.

Cephalon irregularly and rather sparsely tuberculate; tubercles range from moderately large to small. An irregular row of small tubercles on false preglabellar field; tubercles on occipital ring and borders comparatively small. Inner areas of cheeks pitted. Borders of free cheeks granular, with a row of low tubercles. External surface of pygidium granular, internal moulds almost smooth. Six or more pairs of small tubercles usually distinguishable on axis, spaced at irregular intervals, some on successive rings. Doublure granular.

Immature pygidia lack the full number of segments, the axis is much wider anteriorly and less arched transversely, and the first four pairs of pleuræ end in long, outturned free points. Pygidia of three sizes are figured.

Remarks.—*Encrinuroides stincharensis* (Reed 1928, pp. 63, 67; 1906, p. 120, pl. xvi, fig. 8) from the Stinchar Limestone, Minuntion, is known from only two pygidia, the holotype, BM In.23157, and BM In.52699. Our new species resembles Reed's in the number of segments and in the paired axial tubercles, but differs in the following characters:

1. the axis is narrower, tapers more slowly, and is more strongly arched transversely;
2. the pleuræ are shorter;
3. only the first four pairs of pleural ribs reach the margin of the pygidium;
4. the granulation is finer.

In cranidial construction *E. autochthon* resembles *E. fallax* (Reed 1899, pp. 753–755, pl. xlix, figs. 9–12) from the Tramore Limestone, particularly in the small fixigenal spines, but the pygidia are quite different.

E. contentus (Reed 1914, p. 39, pl. vi, figs. 11, 12), from the Balclatchie Group has up to nine pairs of pleural ribs in the pygidium, the first six of which terminate in long free points, unlike our species. Dorsal shields from Ardmillan (BM In.23289, 23290) demonstrate the cranidium described as *Cybele* (*Cybele*?) *perversa* by Reed (1935, pp. 53–54, pl. iv, fig. 5) to be attributable to the same species as the *E. contentus* pygidium. Consequently *C. perversa* becomes a subjective synonym of *E. contentus*. Undescribed species of *Encrinuroides* are known from the following horizons in the Girvan District: top Stinchar Limestone, *superstes* Shales, Lapworth's Shales at Craighead Quarry, and the Upper Drummuck Group. The hypostome of *Encrinuroides* has not been previously described; it does not differ appreciably from that of *Encrinurus*.

Genus *Cybele* Lovén 1846

Cybele sp.

(Pl. III, figs. 26–27)

Material.—2 cranidia, [1 hypostome] from Kirkdominæ.

Description.—Glabella pentagonal, convex; anterior border not developed. Lateral lobes depressed. Basal lobes subcircular, middle lobes narrow proximally, anterior lobes ill defined; middle and posterior lobes discrete. Lateral furrows shallow laterally, deepening into apodemes, anterior and middle pairs oblique, posterior pair transverse, expanding proximally. Occipital furrow short; apodemes at extremities of occipital furrow. Axial furrows broad and shallow. Fixed cheeks large, gently convex. Strong eye ridges run outwards and slightly backwards from opposite anterior glabellar furrows. Posterior borders weakly demarcated by broad furrows. Low, transversely elongate tubercles on anterior margin of glabella. Fixed cheeks closely and shallowly pitted; an acicular tubercle on eye ridge.

[Hypostome and middle body pentagonal in outline. Middle body moderately convex, longitudinal median lobe strongly developed. Anterior wings large. Border furrows deep and narrow, parallel anteriorly, convergent posteriorly. Lateral and postero-lateral borders narrow, gently convex, sloping inwards.]

Remarks.—An unusual feature of this species is the lack of a distinct anterior border.

Genus *Cybeloides* Slocom 1913

Cybeloides terrigena n.sp.

(Pl. III, figs. 28–34)

Diagnosis.—Cranidium broad. Frontal lobe of glabella projects mesially. Lateral lobes narrow; longitudinal furrows shallow; apodemes deep.

Holotype.—A.5246 (cranidium), Pl. III, figs. 28*a*, *b*. Minuntion.

Paratypes.—A.5247 (free cheek). Minuntion. A.5249 (incomplete enrolled exoskeleton). Minuntion.

Other material.—All parts, chiefly cranidia, from Minuntion and Bougang.

Dimensions.—

	Holotype	A.5325
Median length of cranidium	4·7 mm.	4·6 mm.
Width of glabella across lateral lobes (estimated)	4·4 mm.	3·7 mm.
Width of lateral glabellar lobes	1·2 mm.	0·9 mm.
Width of cranidium	. .	15·8 mm.

Description.—Cephalon elliptical, weakly convex transversely; fixigenal spines slender. Glabella pentagonal, sloping gently downwards with weak convexity. Frontal lobe projects mesially, outline strongly oblique laterally; central lobe narrows steadily for greater part of its length, widening at back; a median pit at one-quarter length from front. Tricomposite lateral glabellar lobes elongate, with marked independent convexity, not rising as high as glabella; faint, transverse depressions across lateral lobes opposite middle and posterior apodemes. Longitudinal furrows broad and shallow inbetween apodemes, particularly at front, commencing opposite eye ridges, curving strongly backwards, and joining occipital furrow at a pair of transversely elongated apodemes; anterior and middle lateral apodemes elongated and converging backwards, posterior pair almost longitudinal. Occipital ring short, sloping forwards; transverse convexity strong mesially; a small median tubercle. Axial furrows broad and moderately deep except opposite eye ridges, bowed outwards alongside lateral lobes; fossulæ at front extremities. Fixed cheeks broad, sloping steeply inwards proximally and gently outwards distally. Palpebral lobes almost twice width of glabella apart, situated anterior to middle lateral pair of apodemes. Eye ridges strong, running outwards and slightly backwards from longitudinal furrows. Posterior borders short (sag.)

proximally, widening greatly distally, swollen. Posterior border furrows deep and narrow. Fixigenal spines relatively short, slender, curving outwards and backwards. Anterior branches of facial sutures run almost straight inwards and forwards to the short transverse rostral suture, delimiting frontal lobe of glabella; posterior branches curve outwards and backwards, cutting lateral margins opposite posterior border furrows.

Eye set on long, slender, cylindrical stalk. Free cheek broad, weakly convex. Lateral border narrow, convex, with a broader anterior extension. Border furrow shallow.

Hypostome subtriangular. Middle body triangular, strongly swollen; longitudinal median lobe hardly distinguishable. Middle furrows faint. Lateral borders broad, sloping inwards, evenly convex in outline.

Thorax with axis about one-third the width; apodemes at extremities of articulating furrows. Axial furrows deep and broad. Pleuræ curve strongly outwards, backwards and downwards—the posterior more strongly than the anterior. Pleural ribs broad and swollen, expanding beyond fulcra. Anterior and posterior bands narrow. Pleural furrows sharp.

Pygidium cuneiform, three-quarters as wide as long, strongly arched transversely. Axis two-fifths maximum width, and three-quarters length of pygidium, gently concave longitudinally, apex strongly rounded. First ring well defined, considerably wider than rest of axis; subsequent rings ill defined, ring furrows extending for one-third width of axis only. Axial furrows become shallow posteriorly. Pleural lobes slope strongly outwards; four pairs of pleuræ ending bluntly at lateral margins and extending successively further backwards. Pleuræ consist of a swollen posterior rib, separated by a broad furrow from the narrow and weakly developed anterior band; fourth pleuræ faint on interal moulds.

External surface of exoskeleton minutely granular. Cephalon within borders sparsely tuberculate. A shallow median pit on frontal lobe. Cheeks finely and closely pitted; borders devoid of tubercles. Ribs of thoracic and pygidial pleuræ with one or two low tubercles; anterior bands of pygidium finely pitted.

Remarks.—The cranidium of this species bears a strong resemblance to *Paracybeloides girvanensis* (Reed 1906, pp. 126–128, pl. xvii, figs. 1–4) from the Drummuck Group, particularly in the weak development of the longitudinal furrows. The pygidium differs in lacking the elongated free points, which must be regarded as the characteristic feature of *Paracybeloides*. The hypostome of *C. terrigena* differs from that of *P. girvanensis* and *C. viginiensis* Cooper (1953, pp. 31–32, pl. xiii, figs. 1–14, 18–20) in lacking spines or prominences on the posterolateral border.

Family CALYMENIDÆ Burmeister 1843

Genus *Thulincola* n.gen.

Diagnosis.—Anterior lateral glabellar lobes weakly developed. Middle and posterior lateral furrows faint distally. Glabella defined by narrow preglabellar and axial furrows. Preglabellar field lacking mesially. Facial sutures cut posterior borders some way down the partially composite genal spines. A row of small spines on underside of border of free cheek. Posterior border of hypostome deeply notched. Pygidium short; axis long, broad and swollen; four pairs of furrowed pleuræ strongly defined. Surface finely tuberculate.

Type species.—*Thulincola barbarus* n.sp.

Remarks.—So far as is known the genus is monotypic. It differs from *Pharostoma* Hawle and Corda in the cranidial characters listed above, and from *Pharostomina* Sdzuy in the spines on the free cheeks, in the notched hypostome, and in the furrowed pygidial pleural lobes.

Thulincola barbarus n.sp.

(Pl. IV, figs. 1–9)

Diagnosis.—As for genus.

Holotype.—A.5345a, b (cranidium). Pl. IV, figs. 1*a*, *b*. Kirkdominæ.

Paratypes.—A.5350a, b (cephalon, hypostome and thoracic segments); A.5348a, b (dorsal shield lacking free cheeks). Kirkdominæ.

Other material.—27 cranidia, 3 free cheeks, 1 hypostome, 2 thoraces with pygidia, 11 pygidia. Kirkdominæ.

Material from other horizons.—Cranidia from the top Stinchar Limestone, Auchensoul.

Dimensions.—

	Holotype	A.5346a, b
Median length of cranidium	2·6 mm.	2·0 mm.
Width of cranidium	4·1 mm.	3·8 mm.
Length of central lobe	1·8 mm.	1·3 mm.
Width of glabella across basal lobes . . .	1·6 mm.	1·5 mm.
Width of glabella across anterior lobes . .	1·3 mm.	1·2 mm.

Description.—Cephalon semicircular; librigenal spines short and slender. Glabella subrectangular, strongly convex in both directions, elevated above fixed cheeks, extending to anterior border. Central lobe narrows steadily between lateral lobes, occupying at least half basal width of glabella. Basal lateral lobes subtriangular, with moderate independent convexity, fused with central lobe at posterior inner extremities, three-eighths length of glabella. Basal lateral furrows indistinct at axial furrows, deepening rapidly into a pair of large, obliquely directed apodemes. Middle lateral lobes short (exsag.), not separated from central lobe, and incompletely separated from anterior and basal lateral lobes. Middle lateral furrows indistinct at axial furrows, deepening rapidly into subcircular apodemes. Anterior lateral lobes small and ill defined. Anterior lateral furrows faint, short, running backwards and inwards. Occipital ring follows convexity and width of glabella, narrowing steadily towards sides. Occipital furrow narrow, deepening laterally. Preglabellar and axial furrows uniformly deep and narrow, delimiting glabella sharply. Small fossulæ immediately forwards of anterior lateral furrows. Anterior border short, gently rounded in outline, weakly convex, horizontally extended. Anterior border furrow confluent mesially with preglabellar furrow. Preocular areas of fixed cheeks moderately broad, projecting a short distance in front of glabella; postocular areas gently convex, sloping outwards. Palpebral lobes comparatively large, sloping inwards, placed opposite middle lateral glabellar furrows. Eye ridges faint, running from opposite anterior lateral furrows to anterior extremities of palpebral lobes. Posterior borders short (exsag.) proximally, lengthening and curving backwards laterally, joining inner parts of lateral borders. Lateral and posterior border furrows broad and shallow, confluent. Anterior branches of facial sutures short, converging slightly, cutting anterior borders approximately one and a half times anterior width of glabella apart; posterior branches curve outwards and strongly backwards, transecting lateral borders and cutting posterior margin some way down the partially composite genal spine.

Free cheek narrow; inner area gently convex. Lateral border broad and convex, a row of about twenty-five short, closely spaced spines on underside. Border furrow sharp. Librigenal spine short, tapering; a strongly swollen, oval area at base of spine.

Hypostome broadly rounded in front. Middle body elongate, strongly swollen. Middle furrows and lateral lobes not distinguishable. Lateral furrows broad and deeper than posterior furrow. Anterior wings large, sloping dorsally upwards. Lateral borders sloping inwards, widening rapidly posteriorly. Posterior forks sharply pointed, convex; median indentation broad, rounded.

Thorax composed of at least twelve segments, narrowing little backwards. Axial rings gently convex from front to back, strongly arched transversely. Axial furrows narrow. Pleuræ slope steeply outwards with even convexity. Pleural furrows faint but persistent. Pleural extremities narrowly rounded. Articulating half-rings and facets strong.

Pygidium small, semicircular. Axis swollen, three-eighths maximum pygidial width, narrowing slightly to a broad, rounded apex near posterior margin. Eight axial rings; anterior ring furrows deep, posterior faint throughout. Axial furrows deep and narrow. Pleural lobes strongly convex. Four pairs of pleuræ marked off by deep furrows; a small fifth pair alongside postaxial area; pleuræ almost straight, divergence decreasing successively.

Family PTERYGOMETOPIDÆ Reed 1905

Genus *Calliops* Delo 1935

Calliops marginatus n.sp.

(Pl. IV, figs. 10–17)

Diagnosis.—Anterior border of cranidium horizontally extended, clearly marked off from glabella. Middle lateral glabellar lobes narrow laterally. Eyes do not reach posterior border furrows. Surface non-tuberculate.

Holotype.—A.5237 (cranidium). Pl. IV, fig. 10. Bougang.

Paratype.—A.5223a, b (dorsal shield). Auchlewen Burn.

Other material.—All parts except hypostomes from Bougang, Minuntion, Auchlewen Burn and Benan Burn.

Dimensions.—

	Holotype	A.5332
Length of cranidium	6·1 mm.	7·9 mm.
Width of cranidium	9·3 mm.	11·6 mm.
Width of glabella across frontal lobe . . .	5·1 mm.	6·3 mm.
Width of glabella across basal lobes . . .	2·9 mm.	3·0 mm.

Description.—Cephalon subsemicircular, moderately convex in both directions; fixigenal angles rounded. Glabella trapezoidal, sloping strongly downwards with moderate convexity. Frontal lobe broadly pointed mesially, lateral angles rounded. Anterior lateral lobes about one-third length of glabella, with moderate independent convexity, bluntly pointed in front. Middle lateral lobes small, only faintly separated from anterior lateral lobes, narrowing laterally and only just reaching axial furrows. Basal ring relatively long, undefined mesially with discrete lateral nodes defined by longitudinal furrows. Occipital ring short, sloping forwards, little wider than base of glabella. Anterior lateral furrows well defined, sigmoidal, converging strongly backwards. Middle furrows very faintly impressed, converging forwards. Posterior furrows deep and broad at first, bending forwards and becoming faint at inner angles of lateral nodes. Occipital furrow broad and shallow; apodemes in basal and occipital furrows alongside basal nodes. Axial furrows deep and broad, but shallowing opposite anterior extremities of palpebral lobes; shallow fossulæ just forward of anterior lateral furrows. Anterior border of cranidium horizontally extended, ogive-shaped, marked off from glabella by a furrow on external surface, but only by change in slope on internal moulds. Fixed cheeks gently convex proximally, sloping steeply outwards laterally. Palpebral lobes broad, widest at mid-length; posterior extremities of lobes considerably further apart than anterior extremities. Palpebral furrows well defined. Posterior borders convex, widening laterally, depressed. Border furrows deep and narrow proximally, becoming shallower laterally, transverse. Genal angles abruptly rounded. Anterior branches of facial sutures curve forwards and inwards, subparallel to preglabellar furrow for one-quarter width of frontal lobe, diverging strongly mesially; the two branches join well inside margin of cephalon; posterior branches curve slightly forwards and outwards.

Eye only moderately rounded in outline; anterior extremity opposite anterior glabellar furrow; posterior extremity almost reaches posterior border furrow. Lens surface almost vertical, composed of about twenty vertical rows of lenses with seven lenses in the longest rows. Free cheek narrow, concave proximally, separated from eye by a shallow furrow. Lateral border convex, not clearly defined. Cheeks connected on dorsal surface by a band which is broader than anterior border of cranidium laterally, but much narrower mesially. Doublure convex posteriorly, flattened anteriorly, widening rapidly forwards, two-sevenths length of cephalon mesially; in ventral view, a shallow depression, widening forwards, along inner margin.

Thorax with axis less than one-third anterior width. Articulating furrows deep and broad, apodemes at extremities. Axial furrows strong. Pleuræ swollen, directed straight outwards at first, then gently backwards; fulcra strong, situated beyond mid-width; extremities rounded. Pleural furrows deep and broad, oblique.

Pygidium subtriangular, two-thirds as long as wide. Axis one-quarter anterior width of pygidium, strongly convex transversely, narrowing rapidly at first, almost parallel sided for much of its length, with rounded apex near posterior margin. Eight axial rings clearly defined; posterior one-third length of axis smooth. Ring furrows narrow (sag.), becoming successively shallower towards back. Axial furrows deep and narrow throughout. Pleural lobes curved gently downwards; nine pairs of pleuræ, posterior two pairs short and faintly defined. Pleural furrows sharp, not reaching lateral margins. Interpleural furrows obsolete. Articulating half-ring, and anterior half-pleuræ strongly developed.

Surface smooth or minutely granular. Some specimens show faint tubercles in a V-shaped arrangement on frontal lobe of glabella.

Remarks.—*C. marginatus* is allied to *C. hunteri* (Reed 1914, pp. 52–53, pl. viii, figs. 8–9) from Balclatchie in two unusual features; both species have a flattened anterior border clearly marked off from the glabella, and reduced middle lateral glabellar lobes. The latter feature is most pronounced in *C. hunteri,* in which the middle lateral lobes have been squeezed right away from the axial furrows, but the tendency is quite evident in *C. marginatus* also (Pl. IV, fig. 13).

Genus *Calyptaulax* Cooper 1930

Calyptaulax fœderatus n.sp.

(Pl. IV, figs. 20–25)

Diagnosis.—Anterior border of cranidium horizontally extended, sharply marked off from glabella; anterior lateral glabellar furrows curve strongly inwards. Eyes extend to posterior border furrows.

Holotype.—A.5352a, b (cranidium). Pl. IV, fig. 20. Kirkdominæ.

Paratype.—A.5356a, b (hypostome and thoracic segment); A.5355a, b (pygidium). Kirkdominæ.

Other material.—17 cranidia, 9 free cheeks, 1 hypostome, 5 thoracic segments, 17 pygidia. Kirkdominæ.

Dimensions.—

	Holotype	A.5353a, b
Length of cranidium	3·9 mm.	3·2 mm.
Width of glabella across frontal lobe . .	2·9 mm.	2·5 mm.
Width of glabella across basal lobes . . .	1·7 mm.	1·2 mm.

Description.—Glabella much wider anteriorly than posteriorly, convexity strong in both directions. Frontal lobe broadly rounded in outline, lateral angles sharp; a short median embayment occurs on several specimens. Anterior lateral lobes moderately swollen, narrowly pointed anteriorly. Middle lateral lobes narrow laterally. Basal ring long and strongly arched mesially, with discrete lateral nodes. Anterior lateral furrows curve strongly inwards with increasing convexity, narrow. Middle furrows converge slightly forwards, shallow laterally, deepened into apodemes proximally. Posterior furrows directed backwards at first, bending sharply forwards at inner angles of basal nodes. Occipital ring long, sloping gently forwards, strongly arched transversely, lateral lobes partially defined by longitudinal furrows. Occipital furrow shallow mesially; apodemes in basal and occipital furrows alongside basal nodes. Axial furrows deep and narrow, small fossulæ opposite anterior lateral furrows. Anterior border of cranidium short, horizontally extended, separated from glabella by a narrow furrow. Fixed cheeks more or less strongly swollen proximally, sloping inwards. Palpebral lobes broad, strongly curved, extending from axial furrows almost to posterior border furrows, anterior and posterior extremities equally far apart from mid-line of glabella. Palpebral furrows strong. Posterior borders level with cheeks, short proximally, lengthening laterally. Lateral borders broad, produced into short, backwardly-directed fixigenal spines. Lens surface of eye slopes outwards, delimited by a faint furrow. Free cheek narrow, widening posteriorly, concave. Surface, except for palpebral lobes and free cheeks, finely tuberculate; a tendency for tubercles to run into ridges on lateral lobes.

Hypostome elongate. Middle body oval, convex, ill defined. Middle furrows short, marking off short posterior lobes. Anterior wings set far back. Postero-lateral borders narrow, pointed.

Axis of thorax with lateral lobes strongly developed. Pleuræ bend sharply downwards; pleural furrows broad proximally, narrowing laterally.

Pygidium subtriangular, composed of nine axial rings and six pairs of pleuræ. Axis tapers steadily to a rounded apex one-sixth length of pygidium from back, strongly arched transversely. Axial rings long. Ring furrows transverse, strongly developed at front, becoming progressively shallower towards back. Axial furrows deep and broad. Pleural lobes convex. Pleural ribs flattened; pleural furrows deep and narrow, just reaching lateral margins; interpleural furrows strong laterally, oblique, not reaching axial furrows. Doublure widens steadily towards back, strongly convex. Dorsal and ventral surface minutely granular.

Remarks.—*C. fœderatus* possesses typical *Calyptaulax* characters, but it will not be possible to make a close comparison until the North-American species have been fully described.

Calyptaulax sp.

(Pl. IV, figs. 18–19)

Material.—1 cranidium, [1 pygidium]. Minuntion.

Description.—Glabella weakly convex, extending to facial suture. Frontal lobe long and strongly pointed mesially. Anterior lateral lobes elongate, narrowly pointed anteriorly, with little independent convexity. Middle lateral lobes long (sag.) proximally, narrowing rapidly laterally, just reaching axial furrows. Basal ring long, lateral nodes not discrete. Anterior lateral furrows shallow, weakly convergent, sigmoidal. Middle furrows deep and narrow, converging forwards, widening proximally. Posterior furrows deep and narrow, converging backwards at first, then bending forwards and becoming broader for a short distance. Apodemes in middle, basal and occipital furrows a short distance from axial furrows. Axial furrows shallow. Fixed cheeks weakly convex proximally. Palpebral lobes broad, flattened, sloping inwards, weakly rounded in outline, extending from axial to posterior border furrows. Posterior borders set slightly lower than cheeks proximally.

[Pygidium subtriangular, composed of eight axial rings and six pairs of pleuræ. Axis narrow, strongly swollen, apex rounded and near posterior margin. Ring furrows shallow but continuous. Axial furrows deep. Pleural lobes strongly convex laterally. Pleural ribs flattened; posterior ribs directed rather strongly outwards. Pleural furrows deep, reaching lateral margins. Interpleural furrows deeper laterally than proximally, but reaching axial furrows.]

Family Lichidæ Hawle and Corda 1847

Genus *Amphilichas* Raymond 1905

Amphilichas sp.

(Pl. IV, figs. 26–28)

Material.—1 incomplete cephalon, 1 pygidium. Minuntion. [1 cranidium. Kirkdominæ.]

Description.—Glabella relatively short; longitudinal convexity weak posteriorly, increasing anteriorly; transverse convexity weak. Central lobe narrower than lateral lobes opposite eyes. Lateral lobes wide anteriorly. Longitudinal furrows moderately deep, reaching occipital furrow. Occipital ring projects strongly sideways. Occipital furrow deeper than longitudinal and axial furrows. Fixed cheeks convex, sloping away from glabella. Posterior borders swollen, marked off by deep furrows. Anterior branches of facial sutures run parallel to, but distant from, axial furrows; posterior branches curve strongly outwards and then bend sharply backwards.

Eye situated posteriorly and close to glabella. Lens surface convex. External rim of eye lobe broad, separated by a strong furrow from eye, and by a deeper furrow from cheek. Free cheek sub-triangular, projecting strongly outwards, and only slightly backwards. Inner area slopes steeply downwards with moderate convexity, continuous with the stout, blade-shaped librigenal spine, which slopes less steeply. Doublure almost as wide as cheeks; inner part slopes steeply upwards, separated from the less steeply inclined outer part by a broad, deep depression, convex ventrally, which curves inwards anteriorly.

Axis of pygidium broad anteriorly, narrowing little to mid-length, tapering steadily to a point posteriorly. First axial ring clearly defined; second ring furrow indicated at sides. Axial furrows deep and narrow. Three pairs of pleuræ incompletely preserved; first and second pleuræ long (sagitally), strongly furrowed; third pleuræ narrow, incomplete posteriorly, unfurrowed.

Dorsal surface of cephalon and pygidium bears closely spaced tubercles of various sizes. Doublure with closely spaced terrace lines.

[A small cranidium from Kirkdominæ (Pl. IV, fig. 27), 2·0 mm. in length possibly belongs to a different species from the above; the anterior convexity is stronger, the longitudinal furrows become shallow posteriorly, and the tricomposite lateral lobes are pinched in near mid-length.]

Remarks.—The cranidium somewhat resembles *A. ardmillanensis* (Reed 1914, p. 29, pl. v, figs. 1, 1 a) from the Balclatchie Group, but the median lobe is relatively broader. The pygidium is remarkable for the great width and clear definition of the posterior part of the axis. The broad furrow near the inner margin of the doublure of the free cheek is an interesting feature, which has already been figured in *A. shideleri* by Foerste (1919, pl. xvii, fig. 3 b).

Genus *Hemiarges* Gürich 1901

Hemiarges sp.

(Pl. IV, figs. 29–32)

Material.—1 incomplete dorsal shield, 5 cranidia, 3 hypostomes, 2 pygidia from Kirkdominæ.

Description.—Cranidium strongly and evenly convex longitudinally weakly arched transversely. Central lobe of glabella projects moderately in front of lateral lobes; antero-lateral extensions reach half way across lateral lobes, but ill defined; neck of central lobe tapers slowly between bicomposite lobes, expanding opposite posterior lobes. Central and bicomposite lobes with strong independent convexity, posterior lobes flattened. Bicomposite lobes oval, incompletely separated from basal lobes. Occipital lobes set far apart, extending sideways well beyond occipital ring, sloping steeply backwards and downwards, confluent with ill defined posterior lobes at anterior inner angles. Occipital ring tapers rapidly behind occipital lobes, strongly arched transversely. Longitudinal furrows deep and broad and converging rapidly at first, then more slowly, bending outwards at posterior extremities of bicomposite lobes, connected to occipital furrows by broad depressions. Anterior border short, convex, clearly marked. Postocular areas of fixed cheeks convex, sloping outwards. Palpebral lobes stout, elevated, rounded. Posterior borders short (exs.), depressed proximally. Cranidium ornamented by tubercles of various sizes; some very small, largest conical, arranged roughly in pairs on neck of central lobe.

Hypostome four-fifths as long as wide. Middle body broadly rounded in front, three-fifths length of hypostome, weakly convex. Lateral lobes gently swollen. Lateral and posterior furrows deep and broad. Lateral borders sub-parallel at first, curving outwards to posterior wings, convergent posteriorly. Posterior border long (sag.), slightly tumid mesially; posterior margin transverse. Doublure of posterior border extends to posterior furrow, flattened, with a median elliptical boss separated by a narrow furrow from anterior margin of doublure. Middle body tuberculate.

Eleven thoracic segments. Axis one-third width of thorax. Pleuræ short (exsag.), parallel sided, directed straight outwards to fulcrum, there bent downwards and backwards; the broad posterior and narrow anterior pleural bands die out before fulcrum. A single row of large tubercles along posterior bands. Doublure broad, flattened; terrace lines longitudinal, faint, closely spaced.

Pygidium semicircular. Axis one-third anterior width, strongly arched, narrowing slowly to broadly rounded apex; post-axial ridge short. Two axial rings strongly defined. Axial furrows deep. Pleural lobes convex. First and second pleuræ short (exs.), ending in short free points; pleural furrows strong, joining border furrows of anterior ribs. Third pleuræ end in free points separated by a small, rounded, median notch, faintly furrowed. Doublure broad, gently convex. Pygidium sparsely tuberculate.

Remarks.—The specimens described lack diagnostic characters. There is some resemblance to *H. bartoni* Raymond (1925, pp. 128–129, pl. viii, fig. 10), but the bicomposite lateral glabellar lobes are not circumscribed, and the third pleuræ of the pygidium are faintly furrowed. The latter feature occurs in occasional specimens of *H. geikiei* (see Reed 1904, pp. 96–98, pl. xiii, figs. 14–14 a; pl. xiv, fig. 1) from the Drummuck Group, *e.g.* BM In.46988, In.16053.

Family ODONTOPLEURIDÆ Burmeister 1843

Genus *Ceratocephala* Warder 1838

Ceratocephala confinis n.sp.

(Pl. IV, figs. 33–36)

Diagnosis.—Glabella strongly convex in both directions; frontal lobe narrow; lateral lobes ill defined proximally and laterally. Paired occipital spines long, curving outwards. Eyes situated opposite middle lateral lobes.

Holotype.—A.5338a, b (cephalon). Pl. IV, figs. 33–34. Kirkdominæ.

Other material.—2 cephala, 2 cranidia, 1 free cheek from Kirkdominæ.

Dimensions.—

	Holotype	A.5339a, b
Median length of cephalon	2·5 mm.	2·9 mm.
Width of cephalon	4·2 mm.	3·6 mm.
Length of glabella	2·0 mm.	2·2 mm.
Width of glabella across frontal lobe . .	1·3 mm.	1·0 mm.
Width of glabella across basal lobes . . .	2·1 mm.	2·0 mm.

Description.—Cephalon trapezoidal in outline, strongly vaulted, with long librigenal and paired occipital spines. Glabella narrows strongly forwards, strongly convex in both directions, sloping steeply downwards. Central lobe broadly rounded anteriorly, set off from lateral lobes by stronger transverse convexity. Posterior lateral lobes subquadrate, ill defined proximally and laterally, together occupying about one-half basal width, and extending for almost half length, of glabella. Middle lateral lobes obliquely elongate. Anterior lateral lobes constitute narrow ridges between fronto-median lobe and cheeks. Middle and posterior lateral furrows oblique, deepening into apodemes laterally, dying out proximally. Anterior lateral furrows represented by shallow pits. Occipital ring strongly arched transversely, bowed strongly backwards in outline, long (sag.), narrowing out laterally where confluent with fixed cheeks. Occipital lobes faintly defined, narrower than basal glabellar lobes. Paired, rounded occipital spines, approximately equal to glabella in length, arise from posterior central area of ring; spines curve upwards, backwards, and increasingly outwards, their distal ends almost transverse, tapering steadily to narrow points. Posterior band with slight independent convexity. Occipital furrow shallow and transverse mesially; anterior lateral branches deepen abruptly into apodemes behind lateral lobes; posterior lateral branches shallow, running backwards then outwards to extremities of ring. Axial furrows almost obsolete except alongside basal lateral lobes. Anterior border short, transverse. Anterior border furrow strong. Fixed cheeks broad posteriorly, narrowing rapidly towards front, strongly convex. Eye ridges strongly developed, running outwards and backwards from anterior lateral angles of frontal lobe to eyes. Palpebral lobes moderately large, elevated, placed opposite middle lateral lobes. Posterior borders short, depressed considerably below level of cheeks. Posterior border furrows shallow, widening strongly laterally. Anterior branches of facial sutures converge forwards a short distance from eye ridges; posterior branches curve outwards and backwards, cutting posterior margin steeply just under base of librigenal spine. Doublure extends for full width of occipital ring.

Free cheek large, steeply inclined, projecting downwards considerably beyond cranidium, strongly rounded in outline. Eye placed on short stalk. Inner area of cheek wide, convex. Lateral border uniformly narrow; a row of fifteen or more thorn like spines extend for two-thirds length from front. Posteriorly, cheek and border are drawn upwards and backwards into a long, rounded tapering, divergent librigenal spine, approximately equal to glabella in length. Cranidium sparsely tuberculate; fixed cheeks more closely ornamented than glabella; a single row of tubercles on eye ridges. Occipital tubercle somewhat enlarged, forwardly placed. Free cheeks finely and sparsely tuberculate. Tubercles aciculate.

Remarks.—*C. confinis* bears a strong resemblance to *C. laciniata* Whittington and Evitt (1954, pp. 54–59, pls. vi–ix; text-figs. 1, 13–16) from the Edinburg Limestone, and a less close resemblance to *C. triacantheis* Whittington and Evitt (1954, pp. 59–60, pl. xxv; pl. xxvi, figs. 1–17) from the Lincolnshire Limestone. *C. confinis* differs from *C. laciniata* and resembles *C. triacantheis* in the more posterior position of the eyes and in the construction of the free cheeks.

General Remarks and Conclusions

1. The *confinis* Flags yield a shelly fauna, without graptolites, in which both trilobites and brachiopods are moderately common. Of the thirty-six species recorded, not more than five occur at other horizons, and not one has been recognized outside the Girvan area.

2. The best localities are Bougang, Kirkdominæ and Minuntion, each with a distinctive fauna; only one species is common to the three localities. Field evidence indicates that Bougang is the oldest, Minuntion the youngest deposit, but Professor Alwyn Williams' work shows that the brachiopod fauna is similar throughout and the difference in age is slight. Environmental control appears to be the most likely explanation of the differences between the faunules.

3. The only earlier shelly horizon in the district is a shaley limestone (Auchensoul Limestone of Williams 1962, *in the press*) interleaved in the top of the Kirkland Conglomerate in the bed of the River Stinchar below Dularg Farm. The following forms, none of which is certainly identical with a *confinis* Flags species, have been obtained at this locality:

Trinodus sp.
Remopleurides 2 spp.
Isotelus sp.
Illænid
Harpid
Lonchodomas sp.
Sphærexochus sp.
Cybele sp.
Amphilichas sp.
Ampyx sp.

4. The Auchensoul Limestone and *confinis* faunas are of particular interest on account of their early position in the Girvan succession; the genera constitute a normal Middle Ordovician association for the Girvan area; most of the genera recur at several higher horizons. There is no evidence of a link with earlier British trilobite faunas. The occurrence of the genus *Prœtidella* might suggest some communication with contemporary Anglo-Welsh faunas, but the absence of trinucleids precludes this conclusion. There is only a slight resemblance to the Tramore Limestone fauna of Southern Ireland.

5. The assemblage of trilobites from the *confinis* Flags bears a close resemblance to that of the Lower Edinburg Formation of the Appalachian Valley of the U.S.A. (see Whittington 1959, pp. 384–387). The following seventeen genera are common to both horizons:

Remopleurides
Robergia
Isotelus
Raymondaspis
Illœnus
Otarion
Ampyx
Lonchodomas
Ceraurinella
Sphœrexochus
Sphœrocoryphe
Encrinuroides
Cybeloides
Calyptaulax
Calliops
Amphilichas
Ceratocephala

The opinion that the *confinis* Flags are equivalent to some part of the Lower Edinburg Formation in age is in accordance with Professor Alwyn Williams' conclusion from his study of the brachiopods.

The genera *Otarion, Ceraurinella, Sphœrexochus, Encrinuroides, Cybeloides, Calyptaulax, Calliops, Amphilichas* and *Ceratocephala* are known earlier only from the Chazy and Lincolnshire Formations of North America.

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DESCRIPTION OF PLATES

All the figured specimens except Pl. I, fig. 22, are from the *confinis* Flags. The photographs are of internal moulds unless otherwise stated; the specimens were lightly coated with ammonium chloride before being photographed.

PLATE I

Remopleurides procax n.sp., figs. 1–8 (p. 2)

Figs. 1*a–c*. Cephalon (holotype). Dorsal and frontal views. ×5. Lateral view. ×4. Bougang.

Fig. 2. Cranidium (A.5226). Rubber latex cast from external mould. ×3·5. Minuntion.

Fig. 3. Left free cheek (A.5260a). ×6. Bougang.

Fig. 4. Cranidium showing two pairs of lateral glabellar furrows (A.5230). External mould. ×3·5. Minuntion.

Fig. 5. Cranidium, free cheeks showing pit in doublure, and thoracic segments (A.5229). Rubber latex cast from external mould. ×4. Minuntion.

Fig. 6. Cranidium and two thoracic segments (GSE 11886). ×4. Bougang.

Fig. 7. Thoracic segments showing axial spine on eighth thoracic ring (A.5290). Lateral view. Rubber latex cast from external mould. ×4. Bougang.

Fig. 8. Ninth to eleventh thoracic segments and pygidium (A.5214). ×4. Bougang.

Remopleurides sp., figs. 9–17 (p. 4)

Figs. 9*a*, *b*. Cranidium (A.5291). Dorsal and frontal views. ×6. Kirkdominæ.

Fig. 10. Front part of doublure of right free cheek (A.5292). Ventral view. ×6. Kirkdominæ.

Fig. 11. Left free cheek (A.5293). External mould. ×10. Kirkdominæ.

Fig. 12. Left free cheek with doublure exposed, showing posterior ledge (A.5294). ×6. Kirkdominæ.

Fig. 13. Hypostome (A.5261b). Rubber latex cast from external mould. ×8. Kirkdominæ.

Figs. 14*a*, *b*. Hypostome (A.5262a). Ventral and ventro-lateral views. ×6. Kirkdominæ.

Fig. 15. Fifth to tenth thoracic segments (A.5216b). External mould, showing base of the slender axial spine at back of eighth ring. ×10. Minuntion.

Fig. 16. Third to eleventh thoracic segments and pygidium (A.5295). ×10. Kirkdominæ.

Fig. 17*a*. Tenth and eleventh thoracic segments and pygidium (A.5263a). ×3·3. Kirkdominæ.

Fig. 17*b*. The same (A.5263b). Rubber latex cast from external mould. ×3·3. Kirkdominæ.

Robergia sp., figs. 18–19 (p. 5)

Fig. 18*a*. Left free cheek (A.5297). ×6. Kirkdominæ.

Fig. 18*b*. The same. Oblique ventral view showing depression running from pit to median suture parallel to margin. ×5. Kirkdominæ.

Fig. 19. Pygidium (A.5298). Rubber latex cast from external mould. ×3. Kirkdominæ.

Isotelus stincharensis (Begg), figs. 20–25 (p. 6)

Figs. 20*a–c*. Cephalon (In.21594). Dorsal, frontal and lateral views. Figured by Reed, 1904, pl. vii, fig. 9. ×1. Minuntion. Gray Collection.

Fig. 20*d*. The same. Doublure of left free cheek showing vincular notch. × 2. Minuntion.

Fig. 21. Dorsal shield (A.5251a). × 1·5. Minuntion.

Fig. 22. Hypostome (In.21595), possibly belonging to this species. × 2. Stinchar Limestone, Minuntion. Gray Collection.

Fig. 23. Doublure of right free cheek, defective at back (A.5299). × 1·5. Minuntion.

Fig. 24. Testate pygidium (holotype, GSM 88880). × 1·5. Minuntion.

Fig. 25. Pygidium (A.5254). × 1. Minuntion.

Isotelus sp., fig. 26 (p. 7)

Fig. 26. Cranidium (A.5218a). × 2. Minuntion.

Homotelus sp., figs. 27–28 (p. 7)

Fig. 27. Cranidium (GSE 11880). × 2. Bougang.

Fig. 28. Pygidium (GSE 11884). × 1. Bougang.

Eobronteus latus n.sp., figs. 29–32 (p. 10)

Figs. 29*a*–*c*. Cranidium (holotype). Dorsal, frontal and lateral views. × 8. Kirkdominæ.

Fig. 30. Cranidium (A.5267a). × 8. Kirkdominæ.

Fig. 31. Part of cranidium (A.5300). External mould. × 13. Kirkdominæ.

Fig. 32. Hypostome (A.5268b). External mould. × 6. Kirkdominæ.

Plate II

Raymondaspis hermaion n.sp., figs. 1–3 (p. 8)

Figs. 1*a*–*c*. Cranidium (holotype). Rubber latex cast from external mould. Dorsal, frontal and left lateral views. × 8. Kirkdominæ.

Figs. 2*a*, *b*. Cranidium (A.5302). Dorsal and frontal views. × 8. Kirkdominæ.

Figs. 3*a*, *b*. Cranidium (A.5269a). Frontal and oblique lateral views showing the strong declivity. × 8. Kirkdominæ.

Kirkdomina williamsi n.gen., n.sp., figs. 4–5 (p. 9)

Figs. 4*a*, *b*. Cranidium (holotype). Dorsal view. × 10, and lateral view. × 8. Kirkdominæ.

Fig. 5*a*. Cephalon (A.5271a). × 10. Kirkdominæ.

Fig. 5*b*. The same (A.5271b). External mould. × 16. Kirkdominæ.

Stenopareia sp., fig. 6 (p. 13)

Fig. 6. Hypostome (A.5272b). External mould. × 3. Kirkdominæ.

Illænus beggi n.sp., figs. 7–9 (p. 11)

Figs. 7*a*–*c*. Cranidium (holotype). Dorsal, lateral and frontal views. × 1·5. Minuntion. Begg Collection.

Figs. 8*a*, *b*. Pygidium (A.5244a). Dorsal and lateral views. × 2. Minuntion.

Fig. 9. Pygidium with doublure exposed (A.5245). × 1·5. Minuntion.

Illænus devexus n.sp., figs. 10*a*–*c* (p. 12)

Figs. 10*a*–*c*. Cranidium (GSE 11881). Dorsal, frontal and lateral views. × 1·5. Bougang.

Illænus sp., figs. 11–14 (p. 12)

Fig. 11. Right free cheek (A.5304). Note elevated eye lobe. × 2. Bougang.

Fig. 12. Left free cheek showing short librigenal spine (A.5307). × 6. Kirkdominæ.

Fig. 13. Left free cheek, genal angle rounded, showing the concave border of the doublure (A.5305). × 6. Kirkdominæ.

Fig. 14. Pygidium showing "*Parillænus*" type of doublure (A.5308). × 6. Kirkdominæ.

Prœtidella sp., fig. 15 (p. 13)

Fig. 15. Cranidium (A.5309). External mould. ×10. Kirkdominæ.

Otarion sp. A, fig. 16 (p. 13)

Fig. 16. Cranidium (A.5273a). ×16. Kirkdominæ.

Otarion sp. B, fig. 17 (p. 14)

Fig. 17. Cranidium (A.5274a). ×15. Kirkdominæ.

Otarion sp. C, figs. 18*a*, *b* (p. 14)

Figs. 18*a*, *b*. Cranidium (A.5375a). Dorsal and frontal views. ×15. Kirkdominæ.

Ampyx harperi n.sp., figs. 19*a*, *b* (p. 14)

Figs. 19*a*, *b*. Cephalon (A.5225). Dorsal view. ×2, and frontal view. ×1. Minuntion. Collected by Dr J. C. Harper.

Lonchodomas tumidum n.sp., figs. 20*a*–*c* (p. 15)

Figs. 20*a*, *b*. Cranidium (A.5217a). Dorsal view. ×4, and frontal view. ×2·5. Minuntion.
Fig. 20*c*. The same (A.5217b). Lateral view of rubber latex cast from external mould. ×2·3.

Ceraurinella sp., fig. 21 (p. 16)

Fig. 21. Pygidium (A.5342b). External mould. ×4. Kirkdominæ.

Bartoninus dispersus n.gen., n.sp., figs. 22–32 (p. 17)

Figs. 22*a*, *b*. Cephalon (holotype). Dorsal and lateral views. ×2. Minuntion.
Fig. 23. Cranidium (A.5208a). Frontal view. ×2. Minuntion.
Fig. 24. Cranidium (A.5207). Rubber latex cast from external mould. ×4·5. Minuntion.
Fig. 25. Cranidium (A.5211a). ×2. Bougang.
Fig. 26. Left eye and part of free cheek (A.5310). ×8. Kirkdominæ.
Fig. 27. Broad hypostome (A.5276a). ×4. Kirkdominæ.
Fig. 28. Narrow hypostome (A.5277a). ×3. Kirkdominæ.
Fig. 29. Hypostome (A.5212b). Part of external mould. ×10. Bougang.
Fig. 30. Thoracic segment (A.5311). ×3·5. Minuntion.
Fig. 31. Pygidium (A.5312). ×3. Kirkdominæ.
Fig. 32. Doublure of pygidium (A.5313). ×2. Bougang.

PLATE III

Sphærexochus eurys n.sp., figs. 1–7 (p. 19)

Figs. 1*a*–*c*. Cranidium (holotype). Dorsal, frontal and lateral views. ×7. Kirkdominæ.
Fig. 2. Cranidium (A.5278a). ×7. Kirkdominæ.
Fig. 3. Small cranidium (A.5314). External mould showing fixigenal spine. ×15. Kirkdominæ.
Fig. 4. Cephalon (A.5279a). Antero-lateral view. ×8. Kirkdominæ.
Fig. 5. Right free cheek (A.5280b). Rubber latex cast from external mould. ×5. Kirkdominæ.
Fig. 6. Hypostome (A.5281a). ×12. Kirkdominæ.
Figs. 7*a*, *b*. Pygidium (A.5282b). Dorsal and posterior views of rubber latex cast from external mould. ×10. Kirkdominæ.

Sphærocorphe saba n.sp., figs. 8–12 (p. 20)

Figs. 8*a*–*c*. Cephalon (holotype). Dorsal, frontal and lateral views. ×8. Kirkdominæ.
Fig. 9. Cranidium with short neck (A.5315). ×8. Kirkdominæ.
Fig. 10. Cranidium (A.5284a). Anterior lobe broken away exposing preglabellar furrow and fossulæ. ×8. Kirkdominæ.

Fig. 11. Incomplete cranidium (A.5316). Lateral view of right cheek showing the lateral spine. ×8. Kirkdominæ.

Fig. 12. Hypostome (A.5317) probably belonging to this species. ×6. Kirkdominæ.

Sphærocoryphe sp. A, figs. 13–14 (p. 21)

Fig. 13. Cranidium (holotype). Rubber latex cast from external mould. ×8. Minuntion.

Fig. 14. Cranidium (A.5240). Rubber latex cast from external mould. ×6. Minuntion.

Sphærocoryphe sp. B, figs. 15–16 (p. 22)

Fig. 15. Cephalon (A.5318). Lateral view. ×6. Kirkdominæ.

Fig. 16. Cephalon (A.5285b). Oblique view of external mould. ×10. Kirkdominæ.

Sphærocoryphe sp. C, fig. 17 (p. 22)

Fig. 17. Cranidium (A.5359b). External mould. ×10. Bougang.

Encrinuroides autochthon n.sp., figs. 18–25 (p. 22)

Figs. 18*a–c*. Cranidium (holotype). Dorsal, frontal and lateral views. Note the small fixigenal spines. ×6. Kirkdominæ.

Fig. 19. Narrow cranidium (A.5287a). ×6. Kirkdominæ.

Fig. 20. Left free cheek (A.5319). ×8. Kirkdominæ.

Fig. 21. Hypostome (A.5288a). ×6. Kirkdominæ.

Fig. 22. Median lobe and anterior border of hypostome (A.5320). Rubber latex cast from external mould. ×15. Kirkdominæ.

Figs. 23*a, b*. Pygidium (A.5289a). Dorsal and lateral views. ×4. Kirkdominæ.

Figs. 24*a, b*. Small pygidium (A.5321). Dorsal and lateral views. ×10. Kirkdominæ.

Fig. 25. Very small pygidium (A.5322). ×15. Kirkdominæ.

Cybele sp., figs. 26–27 (p. 24)

Fig. 26. Cranidium (A.5343a). ×6. Kirkdominæ.

Fig. 27. Hypostome (A.5344a), possibly belonging to this species. ×8. Kirkdominæ.

Cybeloides terrigena n.sp., figs. 28–34 (p. 25)

Figs. 28*a, b*. Cranidium (holotype). Dorsal and oblique left lateral views. ×6·7. Minuntion.

Fig. 29. Cranidium (A.5325). ×3. Minuntion.

Fig. 30. Small cranidium (A.5248). ×6. Bougang.

Fig. 31. Hypostome (A.5326). External mould. ×8. Minuntion.

Fig. 32. Left free cheek (A.5247). External mould. ×8. Minuntion.

Fig. 33. Five thoracic segments and pygidium (A.826). ×6·5. Minuntion. Begg Collection.

Fig. 34. Pygidium (A.5299). Lateral view of rubber latex cast from external mould. ×5. Minuntion.

PLATE IV

Thulincola barbarus n.gen., n.sp., figs. 1–9 (p. 27)

Figs. 1*a, b*. Cranidium (holotype). Dorsal and frontal views. ×10. Kirkdominæ.

Figs. 2*a, b*. Cranidium (A.5328). Dorsal and lateral views. ×10. Kirkdominæ.

Fig. 3. Cranidium (A.5349b). External mould. ×10. Kirkdominæ.

Fig. 4. Cranidium (A.5346a). ×10. Kirkdominæ.

Fig. 5. Left free cheek showing marginal spines (A.5347b). External mould. ×10. Kirkdominæ.

Fig. 6. Hypostome (A.5329). External mould. ×10. Kirkdominæ.

Fig. 7. Pygidium (A.5330). Oblique lateral view. ×15. Kirkdominæ.

Fig. 8. Pygidium (A.5351a). ×15. Kirkdominæ.

Fig. 9. Thorax and pygidium (A.5348b). Oblique lateral view of external mould. ×6. Kirkdominæ.

Calliops marginatus n.sp., figs. 10–17 (p. 28)

Fig. 10. Cranidium (holotype). × 5. Bougang.

Fig. 11. Cephalon (A.5332). × 3. Bougang.

Fig. 12. Cranidium (A.5232b). External mould. × 6·5. Minuntion.

Fig. 13. Cephalon (A.5234). External mould. × 6·5. Minuntion.

Fig. 14. Doublure of cephalon (A.5239). × 3·5. Bougang.

Fig. 15. Right free cheek (A.5236). × 8. Bougang.

Fig. 16. Pygidium with shell preserved on left side showing abnormal development of furrows (A.5238). × 5. Bougang.

Fig. 17. Elongate pygidium (In.52695). × 4. Minuntion. Gray Collection.

Calyptaulax sp., figs. 18–19 (p. 31)

Fig. 18. Cranidium (A.5224). × 4. Minuntion.

Fig. 19. Pygidium (A.762). × 1·5. Minuntion. Begg Collection.

Calyptaulax fœderatus n.sp., figs. 20–25 (p. 29)

Fig. 20. Cranidium (holotype). × 6. Kirkdominæ.

Fig. 21. Cranidium (A.5333a). × 4·5. Kirkdominæ.

Fig. 22*a*, *b*. Cranidium (A.5353a). × 8. Dorsal and lateral views. Kirkdominæ.

Fig. 23. Incomplete hypostome (A.5356a) probably belonging to this species. × 10. Kirkdominæ.

Fig. 24. Pygidium (A.5354a). × 6. Kirkdominæ.

Fig. 25. Pygidium (A.5355a). × 8. Kirkdominæ.

Amphilichas sp., figs. 26–28 (p. 31)

Fig. 26*a*. Cephalon (A.5220a). Note the deep depression on the doublure which marks off the steeply sloping inner area. Oblique right lateral view. × 2. Minuntion.

Fig. 26*b*. The same (A.5220b). Oblique lateral view of rubber latex cast from external mould. × 2·5. Minuntion.

Fig. 27. Cranidium possibly belonging to a different species (A.5360a). × 15. Kirkdominæ.

Fig. 28. Pygidium (A.5221). × 2. Minuntion. Collected by Professor Marshall Kay.

Hemiarges sp., figs. 29–32 (p. 32)

Fig. 29. Cranidium (A.5334). × 10. Kirkdominæ.

Fig. 30. Cranidium (A.5335). External mould. × 6. Kirkdominæ.

Fig. 31. Hypostome (A.5357a). × 6. Kirkdominæ.

Fig. 32. Pygidium (A.5358a). × 6. Kirkdominæ.

Ceratocephala confinis n.sp., figs. 33–36 (p. 33)

Fig. 33*a–c*. Cephalon (holotype). Dorsal, frontal and right lateral views. × 8. Kirkdominæ.

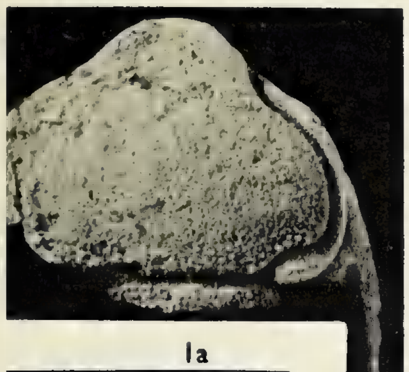
Fig. 33*d*. The same; external mould. Enlargement of eye line and adjacent parts, showing bases of the lateral spines on the free cheek. × 10. Kirkdominæ.

Fig. 34. Cephalon (A.5339a). × 8. Kirkdominæ.

Fig. 35. Cranidium (A.5340a). × 10. Kirkdominæ.

Fig. 36. Cranidium (A.5336). × 10. Kirkdominæ.

R. P. Tripp: "*Trilobites from the* Confinis *Flags (Ordovician) of the Girvan District, Ayrshire*".—Plate I.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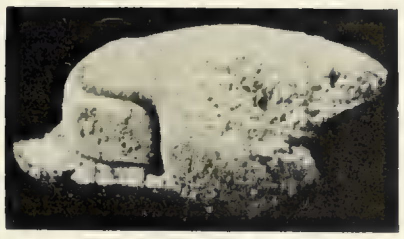
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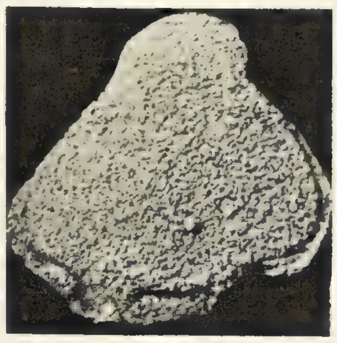
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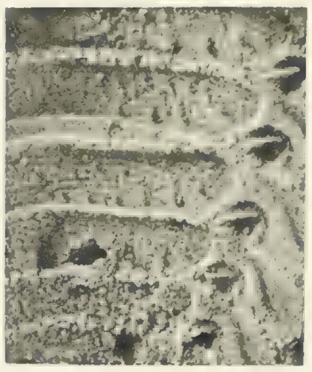
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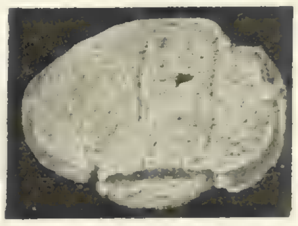
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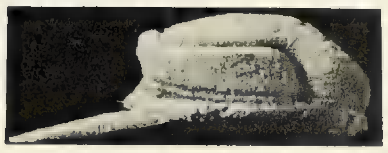
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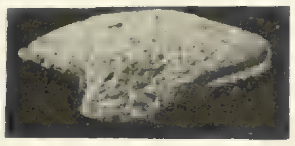
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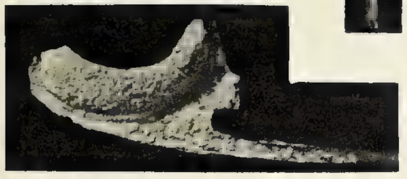
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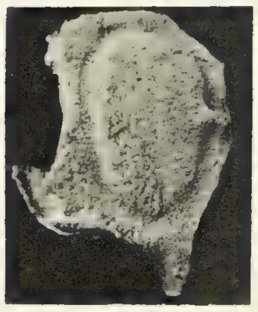
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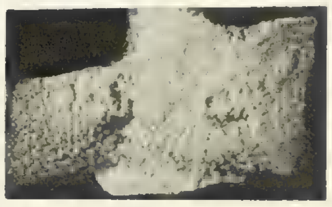
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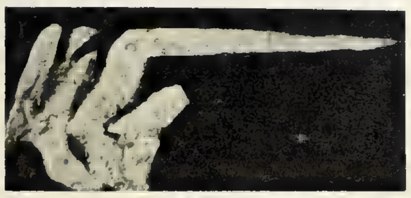
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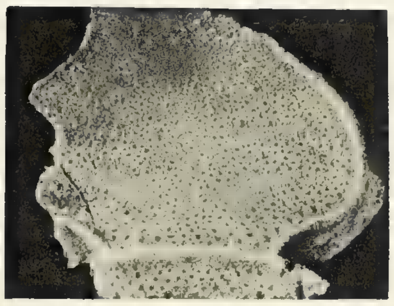
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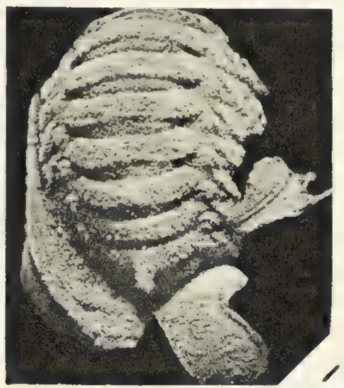
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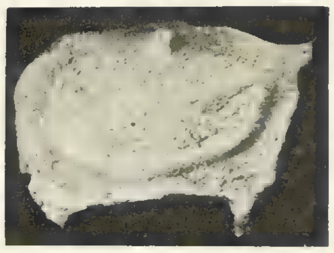
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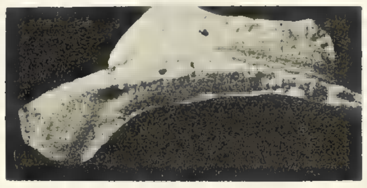
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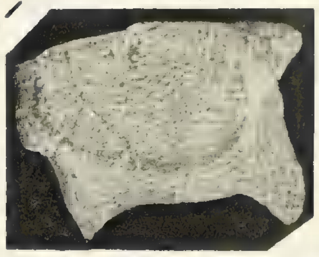
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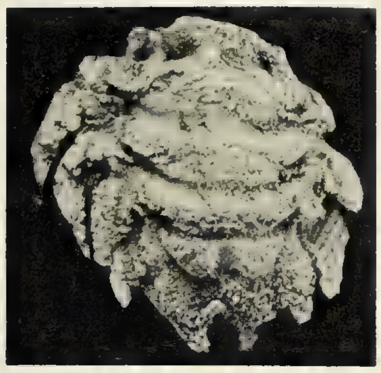
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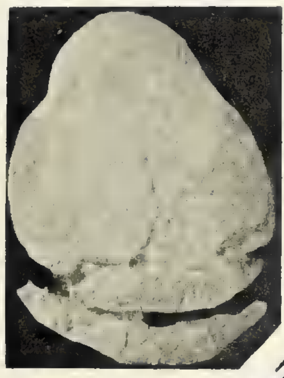
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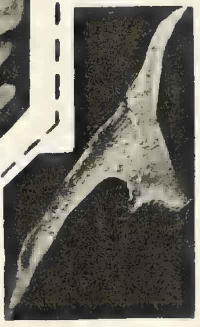
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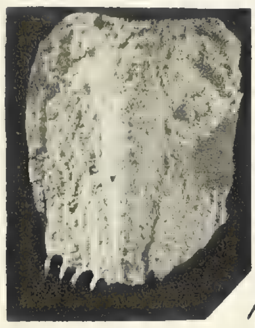
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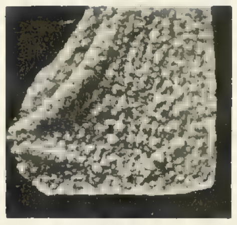
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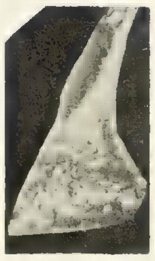
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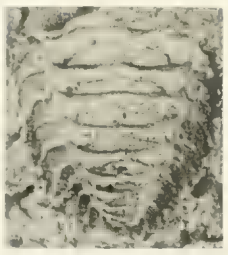
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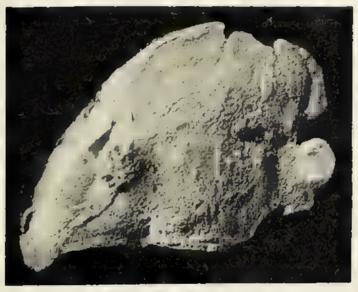
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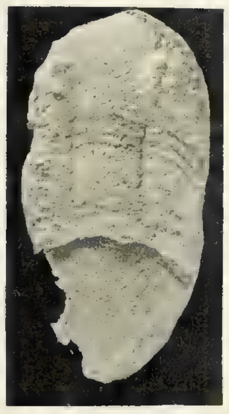
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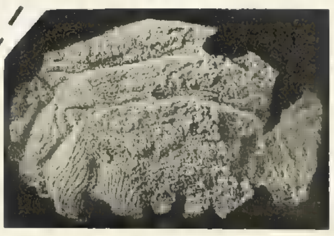
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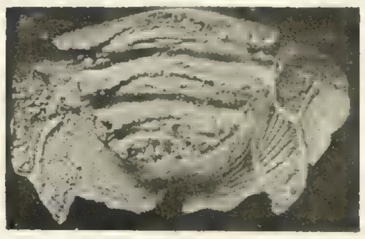
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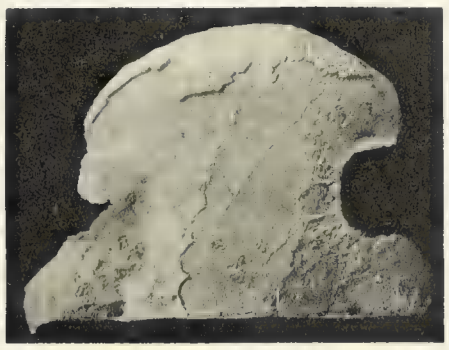
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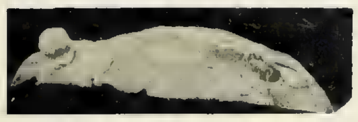
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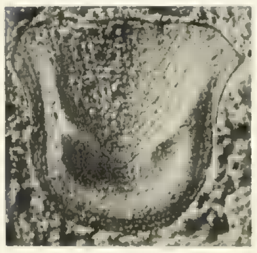
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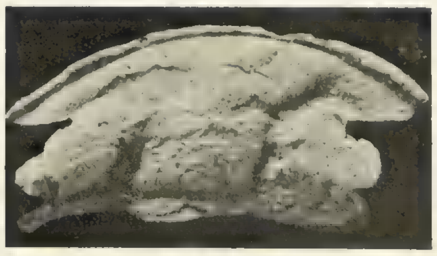
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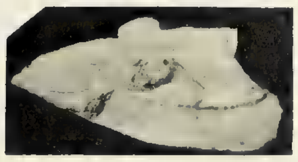
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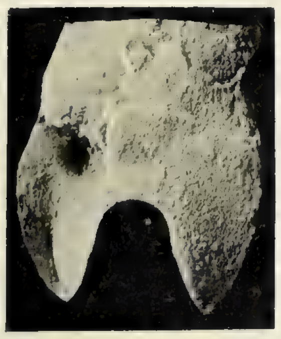
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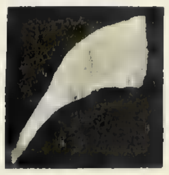
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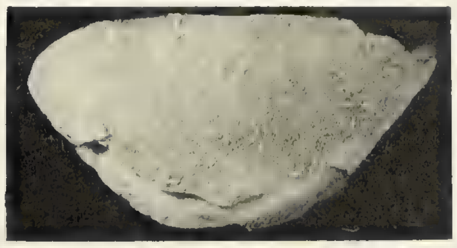
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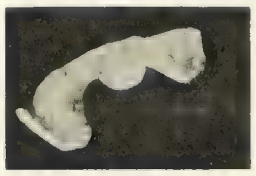
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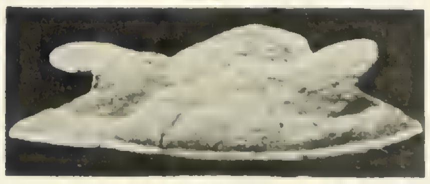
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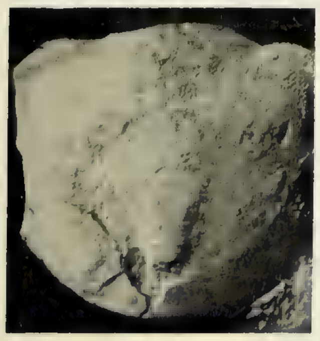
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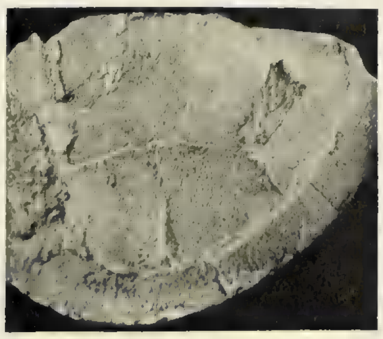
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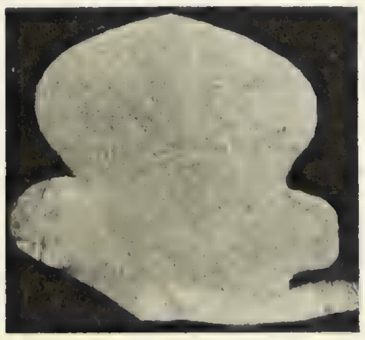
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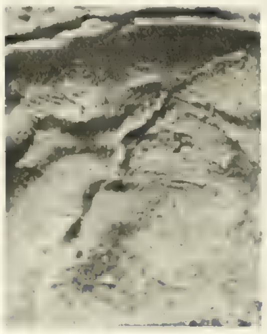
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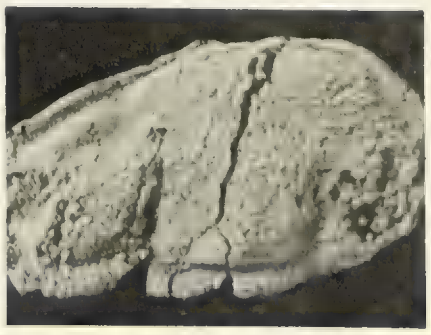
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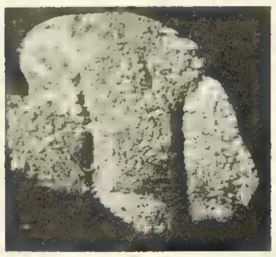
R. P. Tripp: "*Trilobites from the* Confinis *Flags (Ordovician) of the Girvan District, Ayrshire*".—Plate II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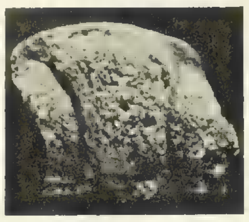
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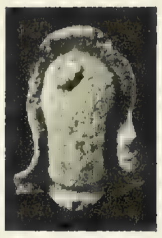
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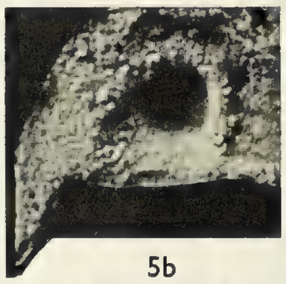
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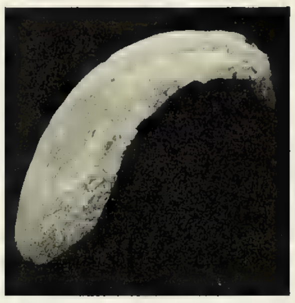
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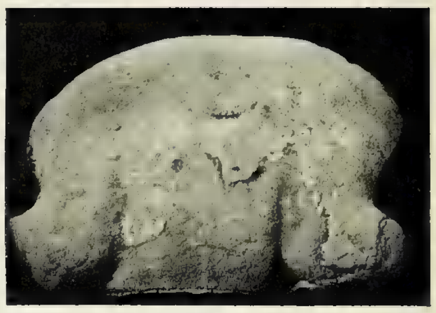
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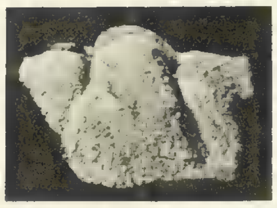
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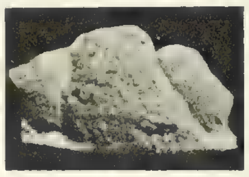
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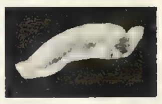
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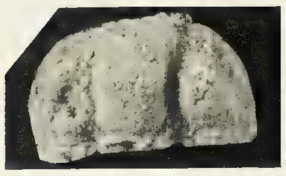
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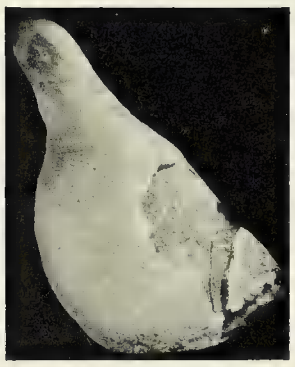
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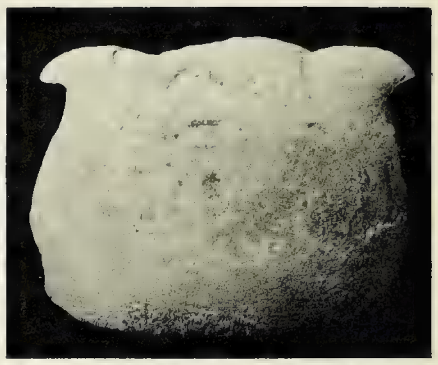
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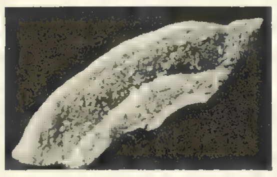
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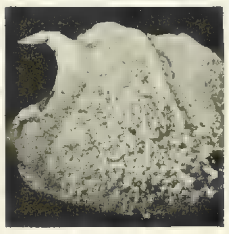
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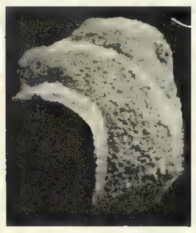
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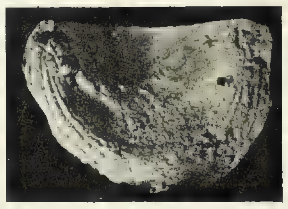
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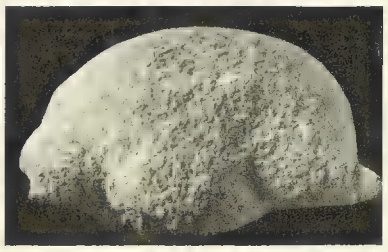
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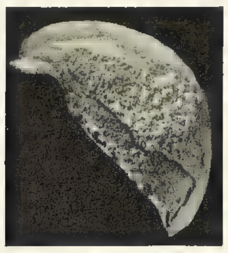
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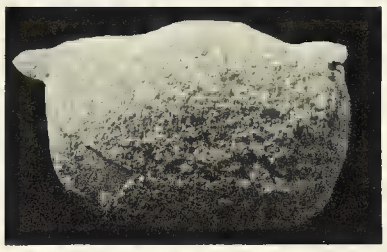
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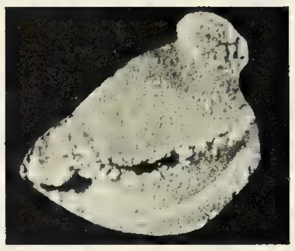
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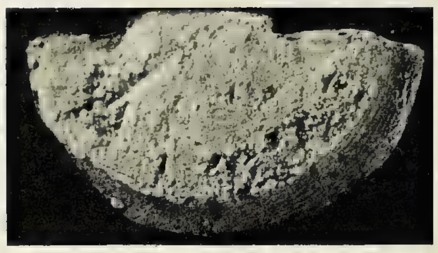
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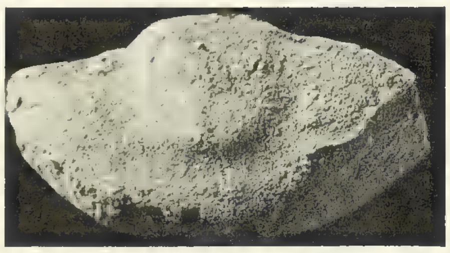
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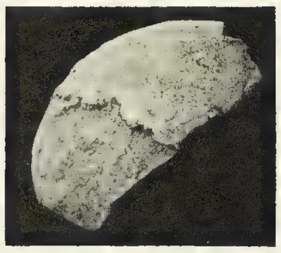
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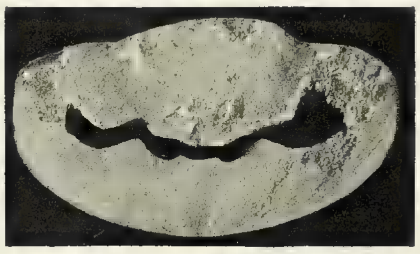
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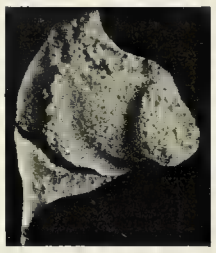
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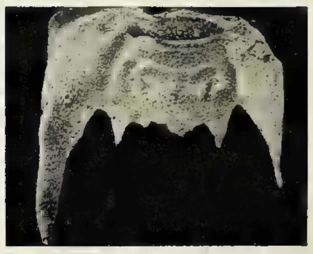
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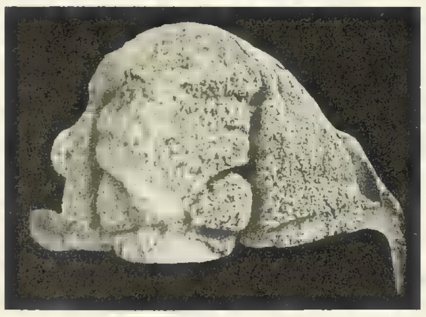
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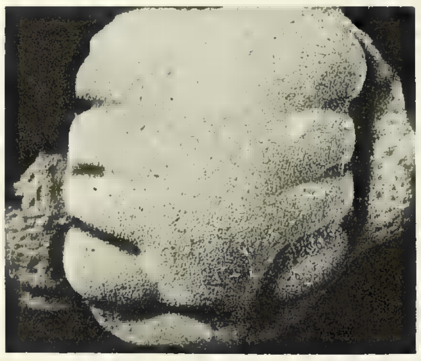
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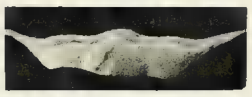
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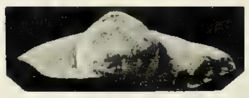
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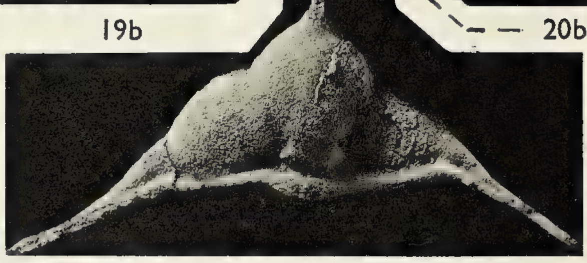
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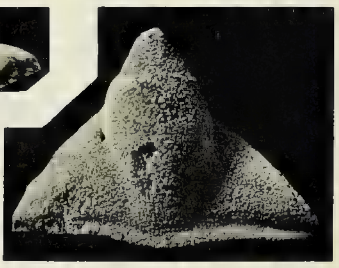
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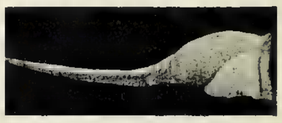
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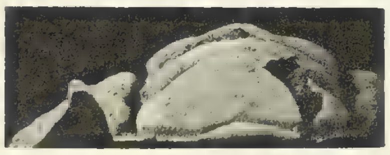
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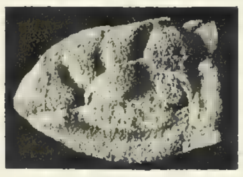
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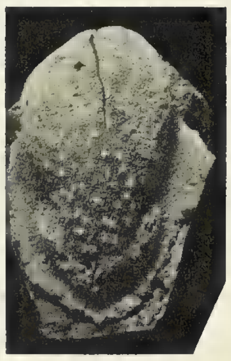
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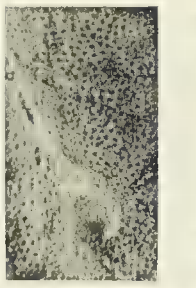
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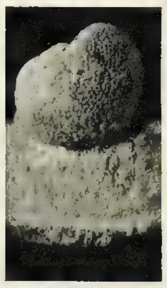
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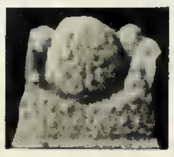
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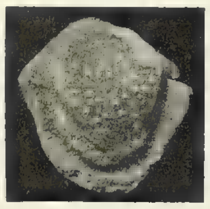
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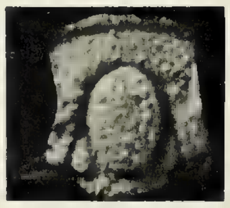
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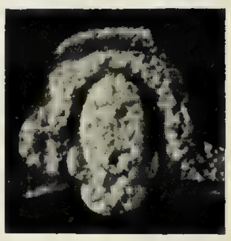
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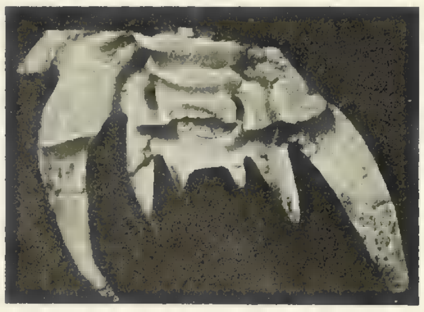
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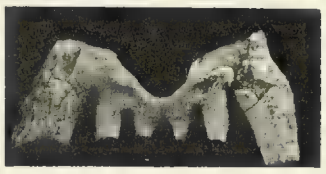
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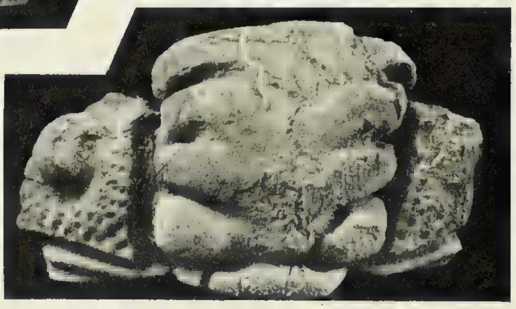
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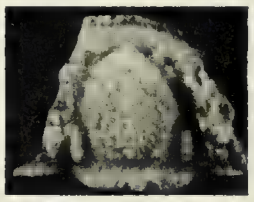
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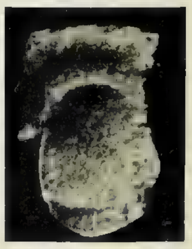
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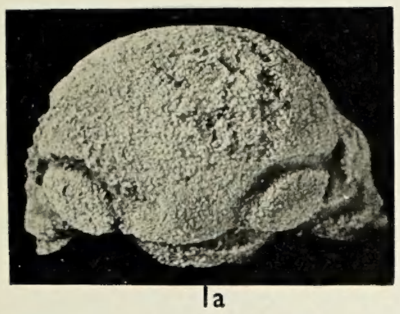
R. P. Tripp: "*Trilobites from the* Confinis *Flags* (*Ordovician*) *of the Girvan District, Ayrshire*".—Plate III.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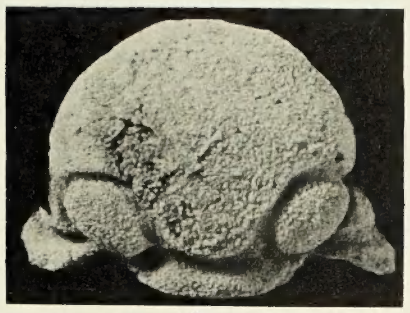
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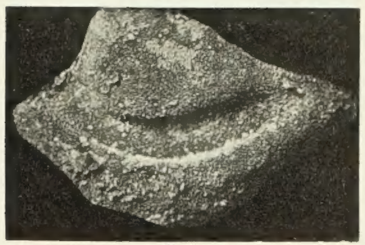
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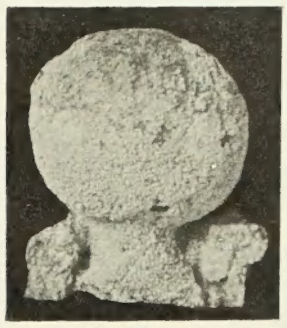
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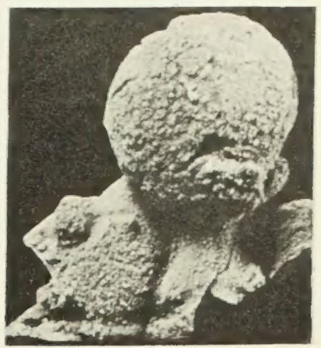
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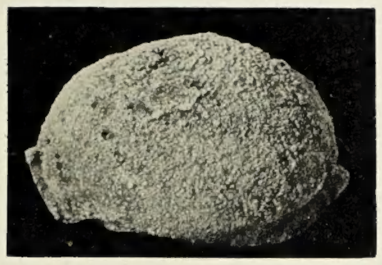
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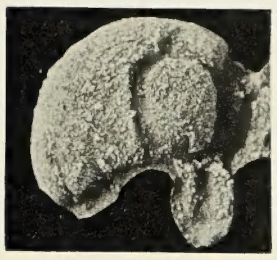
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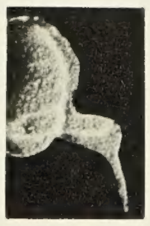
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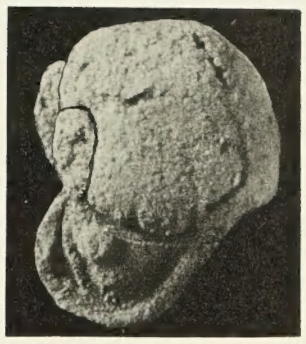
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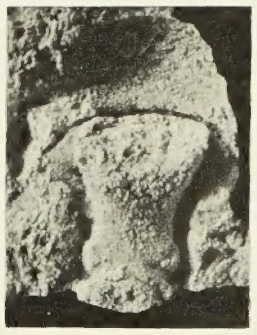
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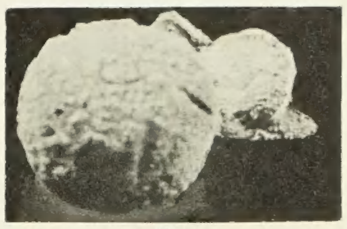
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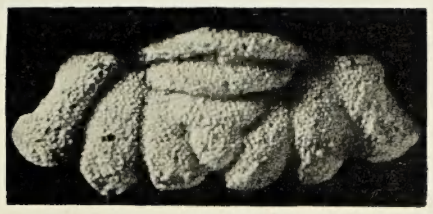
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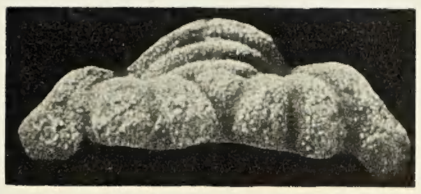
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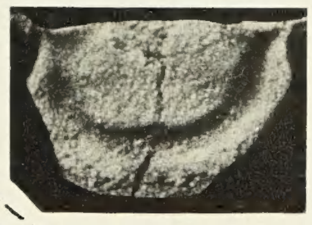
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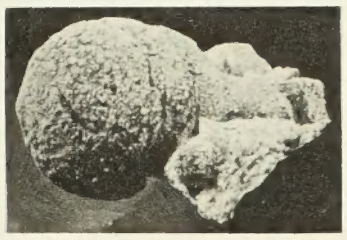
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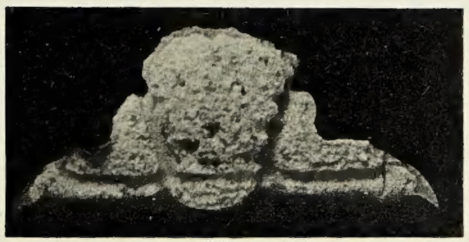
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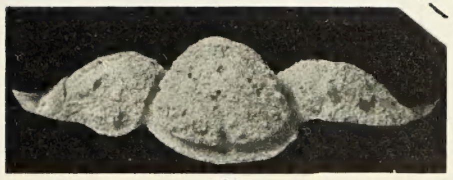
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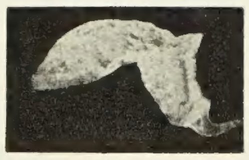
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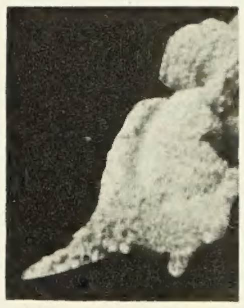
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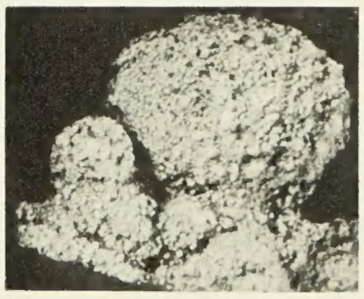
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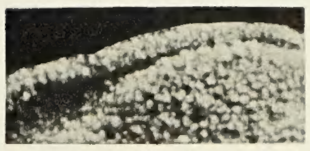
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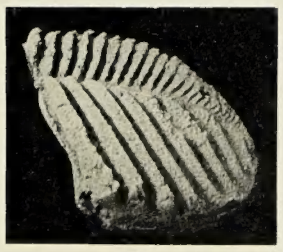
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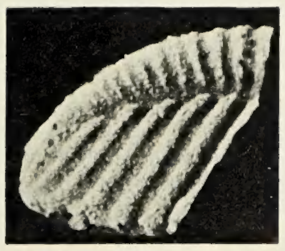
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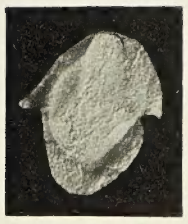
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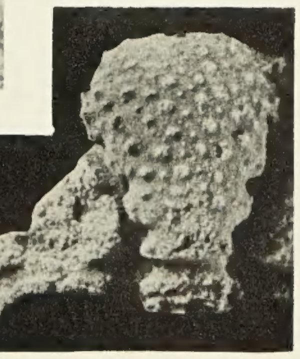
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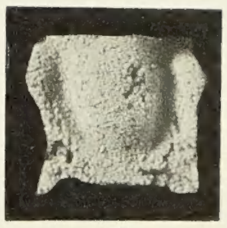
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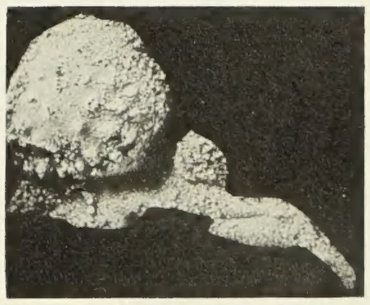
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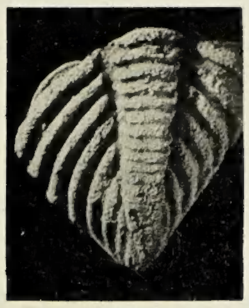
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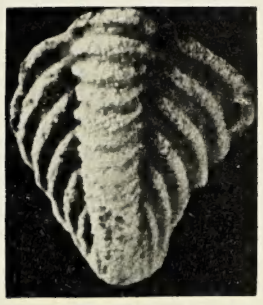
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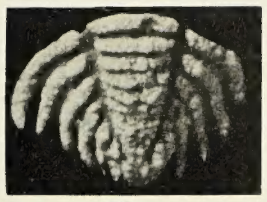
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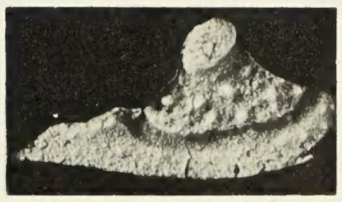
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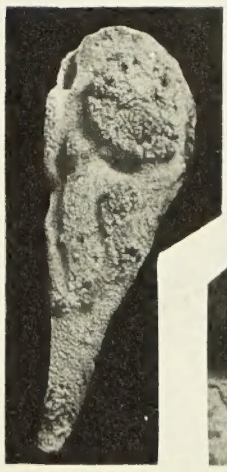
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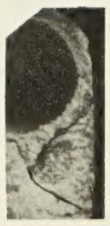
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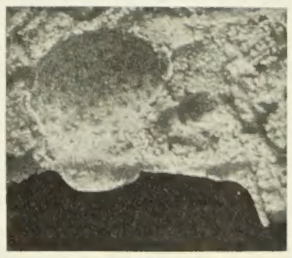
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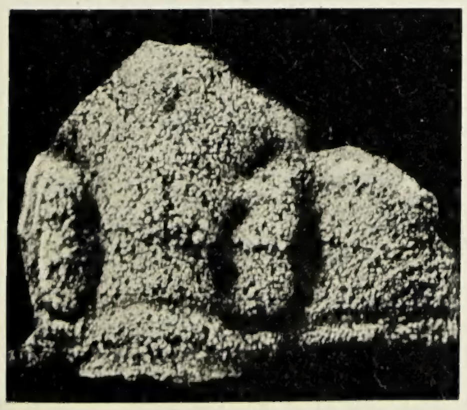
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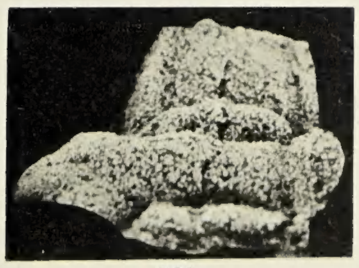
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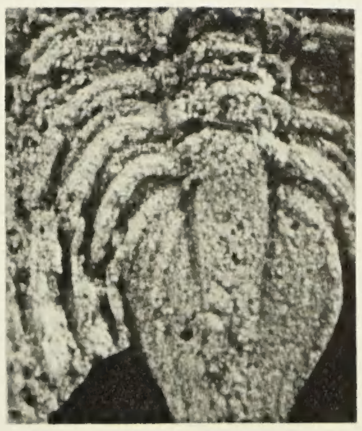
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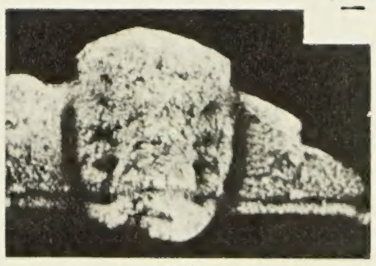
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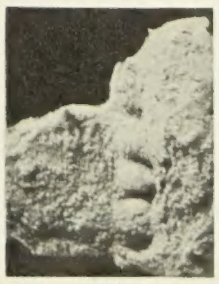
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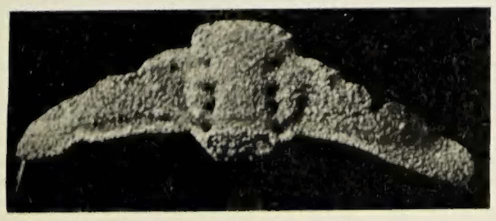
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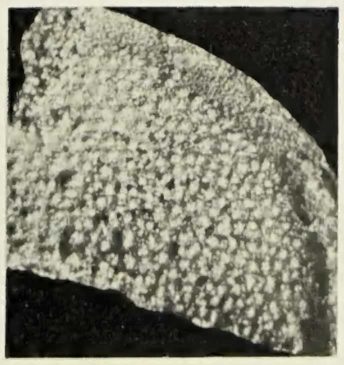
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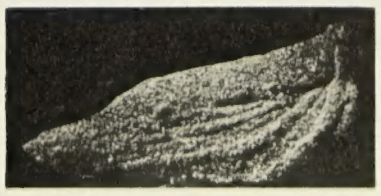
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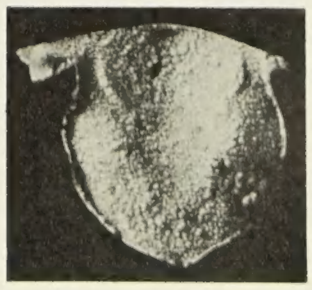
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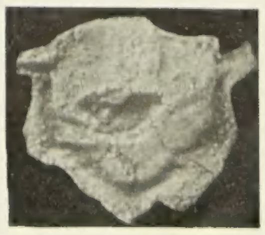
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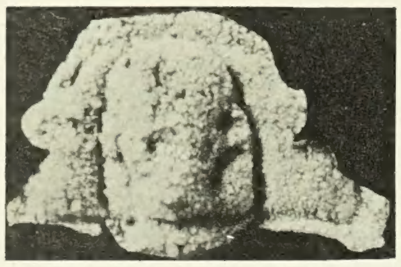
R. P. Tripp: "*Trilobites from the* Confinis *Flags* (*Ordovician*) *of the Girvan District, Ayrshire*".—Plate IV.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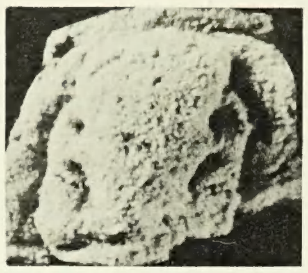
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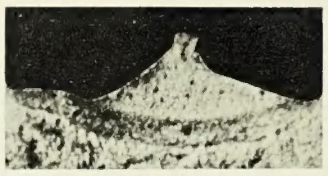
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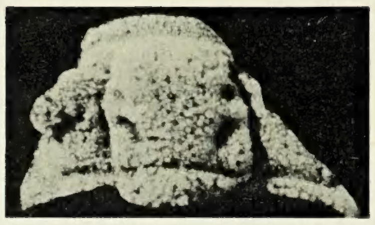
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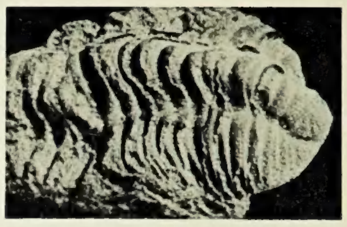
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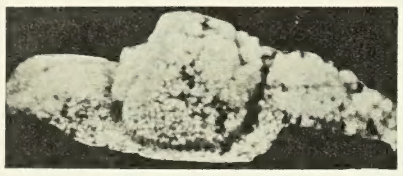
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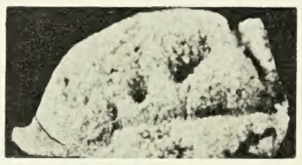
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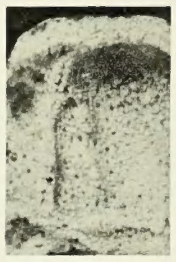
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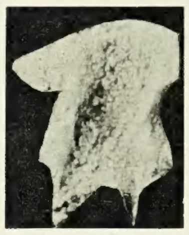
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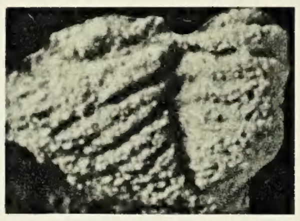
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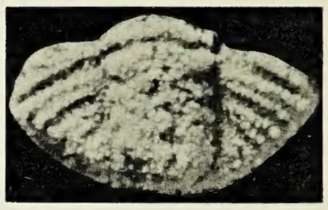
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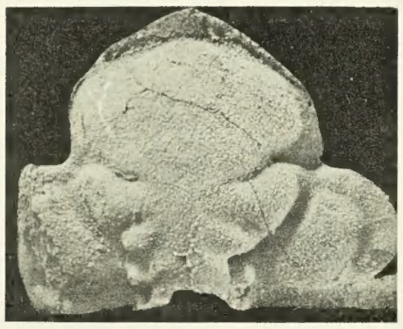
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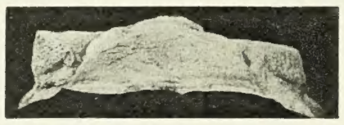
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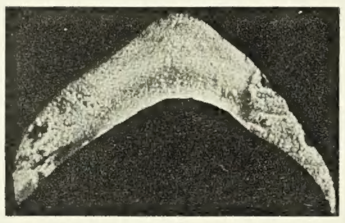
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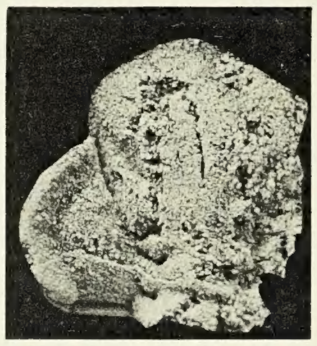
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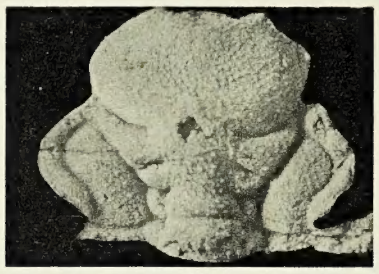
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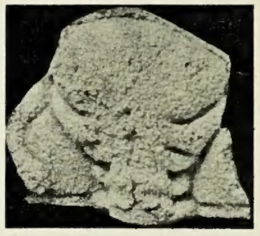
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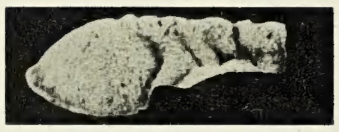
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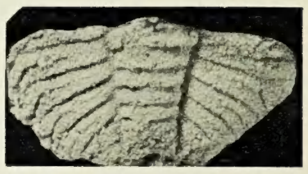
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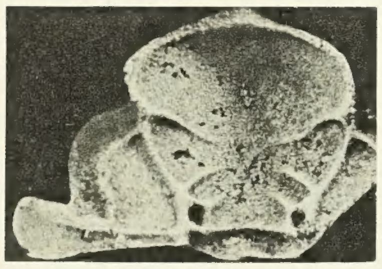
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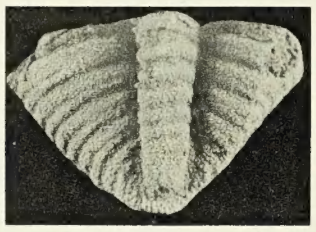
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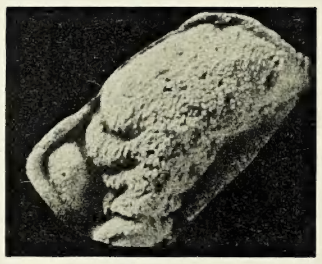
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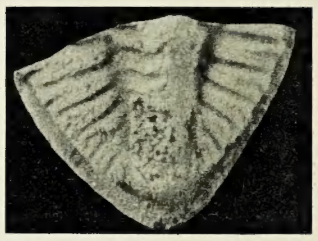
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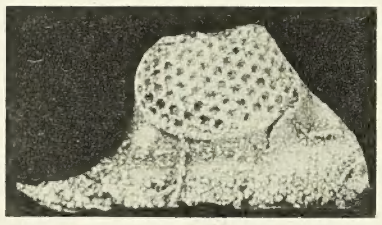
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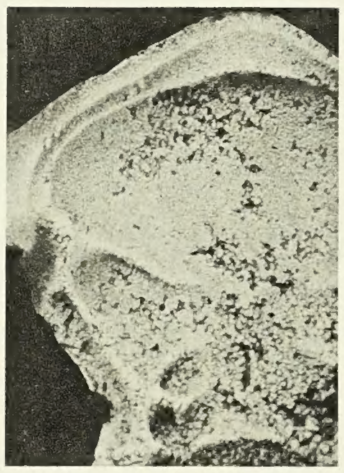
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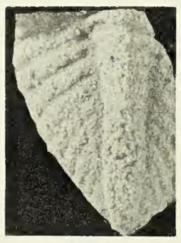
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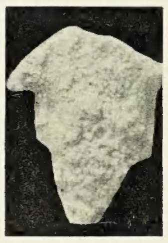
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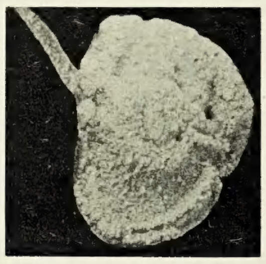
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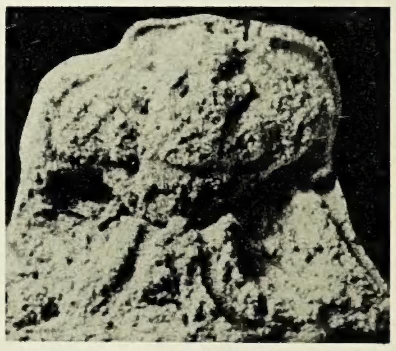
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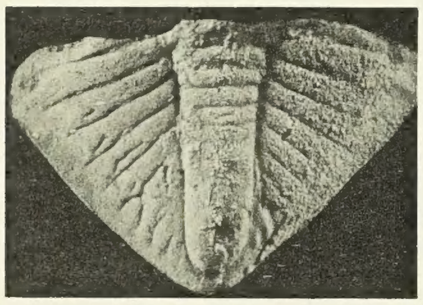
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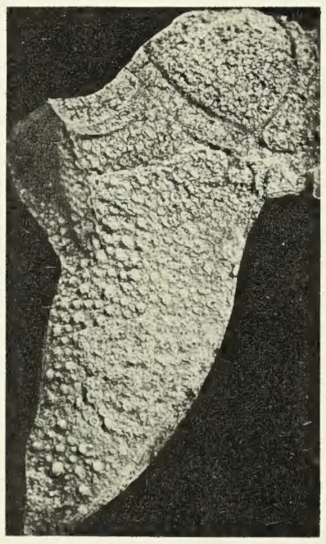
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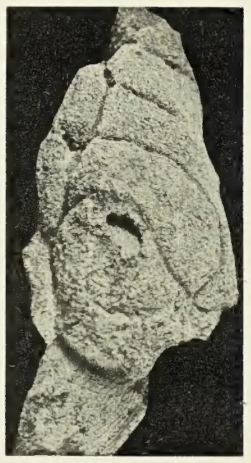
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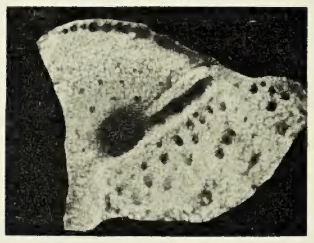
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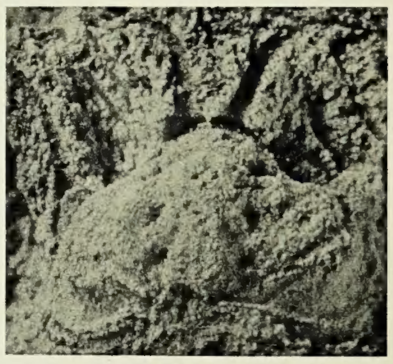
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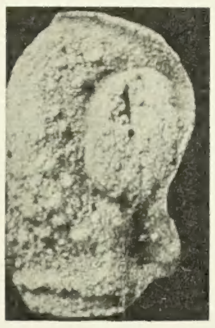
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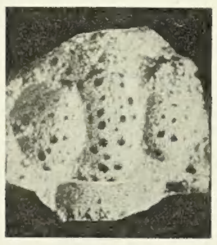
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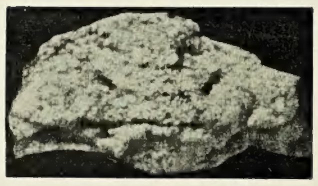
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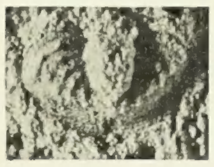
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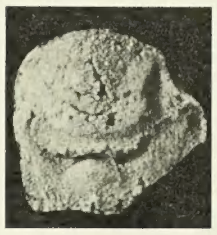
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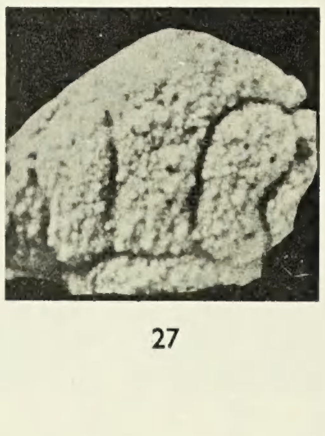
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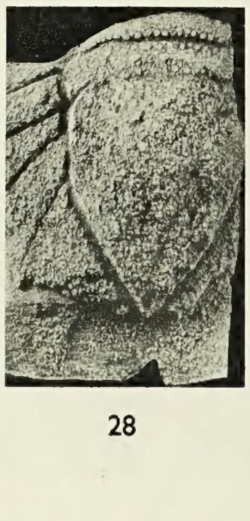
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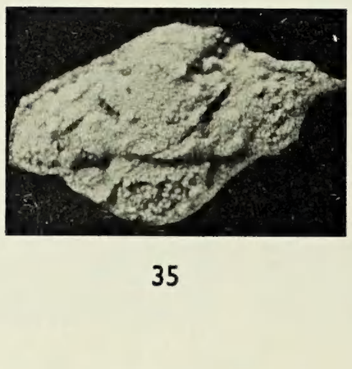
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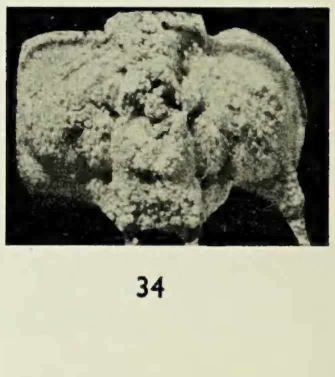
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